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ENGINEERING NEWS-RECORD

A McGRAW-HILL PUBLICATION

OCTOBER 28, 1948

How to Pull Down Costs

A SEVEN-ARTICLE SURVEY OF

SUCCESSFUL, MONEY-SAVING BUILDING METHODS

Plus

Articles on:

A Clearing-House for Sanitary Engineering

Seven-Mile Tunnel Has Eight Changes of Line

BYERS WROUGHT IRON PIPE

In this trench warfare fights against corrosion

This new underground line connects two wells serving the boiler house at an industrial plant. Hazards to pipe life are particularly severe, as the soil contains cinder fill. The engineers looked for a material with extra corrosion resistance . . . and selected wrought iron. As an added precaution, the pipe was coated and wrapped before installation.

Even with ordinary soils, highly aggressive corrosive attack is frequently encountered, and only the use of the right material can forestall early and extensive repairs and replacements. Wrought iron has been used for so many years, in locations all over the country, that its superior resistance is a matter of engineering record, and recommends it for first consideration. For instance:

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. . . In a mid-west community, wrought iron lines were reported as still serving after 43 years. Ordinary materials had lasted only 14 years in the same areas.

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ENGINEERING NEWS-RECORD

October 28, 1948 **Vol. 141, No. 18**

Publication Office—99-129 N. Broadway, Albany 1, N. Y.

Executive and Editorial Offices—330 West 42nd St., New York 18, N. Y.

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Address all communications about subscriptions to Director of Circulation. Price 35c per copy.

Subscriptions	1 year	2 years	3 years
U. S. and possessions	$6	$9	$12
Pan America	10	16	20
Canada	7	11	14
All others	20	30	40

Please indicate position and company connection on all subscription orders.

Entered as Second Class matter October 29, 1936, at the Post Office at Albany, N. Y., under Act of March 3, 1879. Printed in U. S. A.

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Number of copies of this issue printed.....43,960

Index to articles: ***Engineering News-Record*** **issues a semi-annual index, copies of which are available to subscribers on request.** ***Engineering News-Record*** **articles are also indexed in both the** ***Industrial Arts Index*** **and the** ***Engineering Index.***

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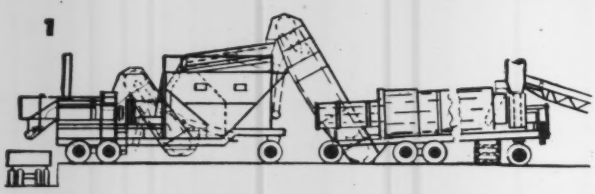
1



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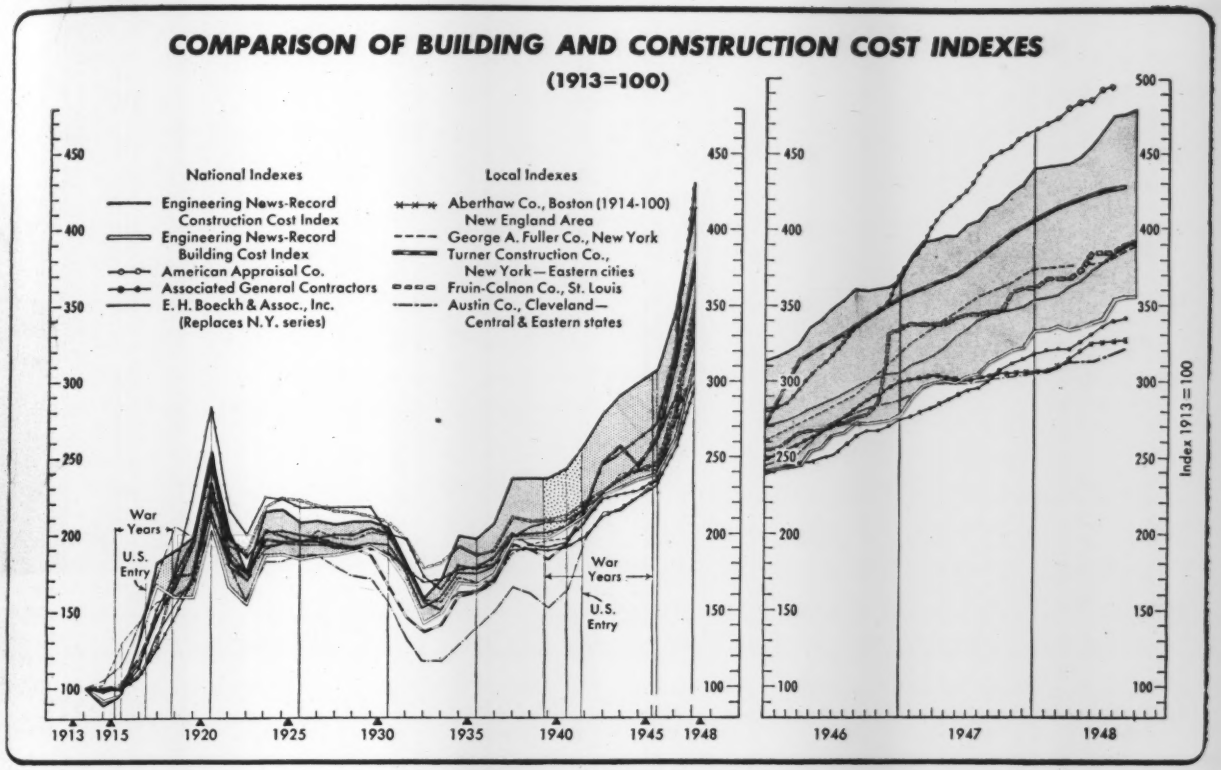
CONSTRUCTION TRENDS


COMPARISON OF BUILDING AND CONSTRUCTION COST INDEXES
(1913=100)
National Indexes
Engineering News-Record Construction Cost Index
Engineering News-Record Building Cost Index
American Appraisal Co.
Associated General Contractors
E. H. Boeckh & Assoc., Inc. (Replaces N.Y. series)
Local Indexes
Aberthaw Co., Boston (1914-100) New England Area
George A. Fuller Co., New York
Turner Construction Co., New York—Eastern cities
Fruin-Colnon Co., St. Louis
Austin Co., Cleveland—Central & Eastern states
War Years
U.S. Entry
War Years
U.S. Entry
Index 1913 = 100
1913 1915 1920 1925 1930 1935 1940 1945 1948
1946 1947 1948

HISTORICAL RECORD OF BUILDING COST INDEXES—1948

WEIGHTED INDEXES	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
ENR Construction	442	443	444	444	445	456	465	477	478	480
ENR Building	334	335	334	335	334	339	342	355	357	357
American Appraisal	472	475	478	481	485	486	493	495	...	...
Associated General Contractors	320	321	321	321	326	332	337	340	341	...
E. H. Boeckh (national average)	353	355	357	362	366	373	379	384	388	...
CONTRACTOR INDEXES										
Aberthaw	...	...	310	...	...	325	...	...	327	...
George A. Fuller	374	...	...	377	...	...	378	...	...	389
Turner	...	417	...	...	...	...	427	...	430	...
Fruin-Colnon	370	370	370	370	384	387	387	387	390	391
Austin	...	...	311	...	...	314	...	...	322	...

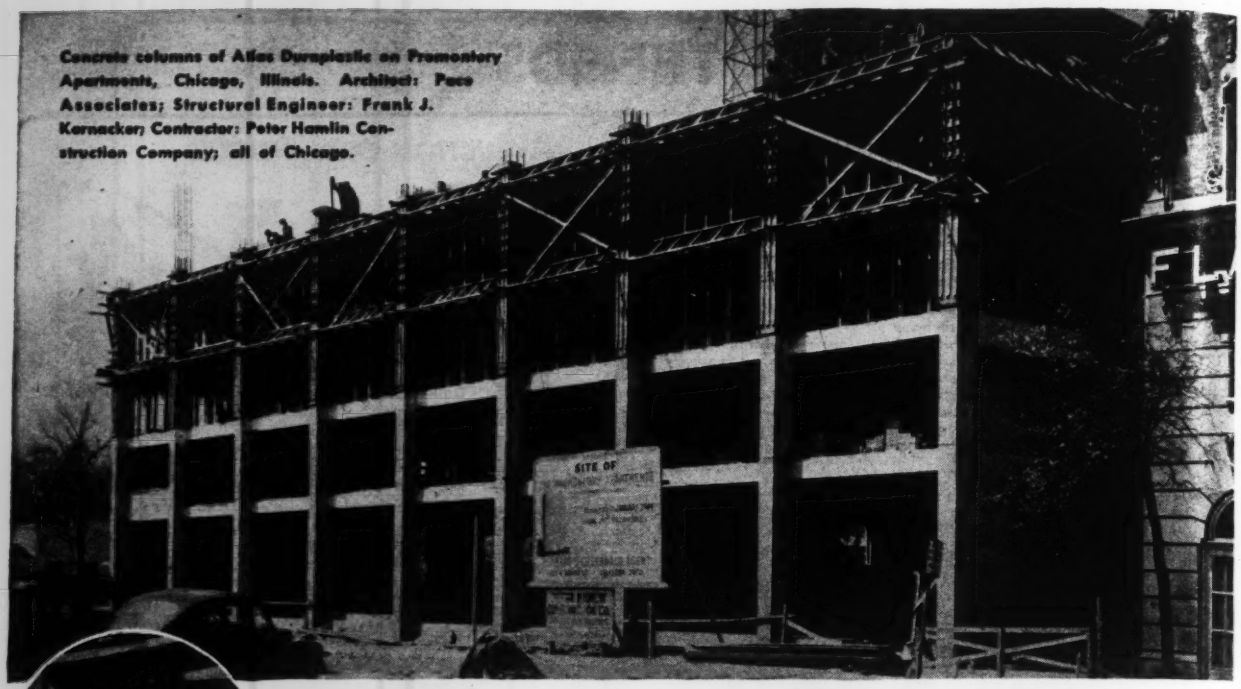
Improved Productivity Indicated by Cost Indexes

Improvement in hidden or intangible building cost elements since the beginning of the year has partially offset increases in the cost of construction materials, which followed the abandonment of the basing point pricing system, and increases in the cost of labor as the result of the third round of wage raises. Contractor building cost indexes which are adjusted for intangible elements such as labor efficiency, management and the availability of materials and labor, rose from 4 to 6 percent in the first nine months of this year, or less than the weighted indexes.

Four of the five contractor indexes tabulated above are computed quarterly or at irregular intervals and a rigid comparison with the weighted indexes is not possible. However, a check of the available contractor indexes show the Fruin-Colnon index in the January-October period rising 5.7 percent and the Fuller index, 4.1 percent, or less than the 8.6 percent and 6.9 percent rises in the *Engineering News-Record* Construction and Building Cost Indexes.

The Aberthaw and Austin building cost indexes, computed quarterly, rose 6.5 percent and 5.2 percent, respectively, from December 1947 to September this year. Both of these indexes showed smaller increases than the weighted indexes for a comparable period of time. The *ENR* Construction Cost Index rose 8.4 percent, the Building Cost Index, 7.2 percent, the Associated General Contractor index, 7.2 percent and the Boeckh index, 11.5 percent.

Despite the improvement in cost intangibles, however, contractor costs are now about double the prewar 1935-39 values. The Fuller and Austin building cost indexes are 2.1 times prewar averages, the Fruin-Colnon index, 1.9 times and the Aberthaw index, 1.7 times. The Turner index is nearly 2.5 times the 1935-39 average.



Concrete columns of Atlas Duraplastic on Promontory Apartments, Chicago, Illinois. Architect: Pace Associates; Structural Engineer: Frank J. Kornacker; Contractor: Peter Hamlin Construction Company; all of Chicago.

Forms in place for concreting with Atlas Duraplastic. Note steel bars and beams that forced work to be done largely by hand.

Finished columns have clean, smooth appearance, free of blemishes or air bubbles.

How Duraplastic licked a tough concrete column problem

Outstanding proof of its placeability—concrete successfully placed in a network of steel 12 feet deep!

Filling the column forms with concrete in this mass of vertical and horizontal steel reinforcement was no easy task.

The columns were 12 feet deep with steel bars and beams so close together that no vibrator could be used. Placing with Atlas Duraplastic air-entraining cement was done entirely by hand using long bars for spading on the inside. Other workmen pounded on the outside of the forms with mallets. Concrete had a slump of approximately 5 inches. Cement content was about 7 sacks per yard and water-cement ratio 5-¾ gallons. There were no signs of bleeding or segregation when the concrete was mixed at ground level, hoisted to the upper floors and distributed to the forms in wheelbarrows.

When the forms were removed, contractors were pleased to find a smooth, excellent-looking surface, free of blemishes or air bubbles.

More and more contractors are profiting from the unique features of Atlas Duraplastic for structural work. More uniform, more workable and more durable, Duraplastic costs no more than regular cement. It provides the proper amount of entrained air by intergrinding with the cement the precise amount of air-entraining material needed for satisfactory field performance. No new methods or materials are required.

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ENR-D-76

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ENGINEERING NEWS-RECORD

OCTOBER 28, 1948 VOL. 141 NO. 18

Construction costs stay up, Public Works Congress told

All segments of industry at forum of American Public Works Association are in agreement that high costs will remain—Wm. A. Xanten of Washington elected president

by Edward J. Cleary

Boston—Anyone entertaining ideas that construction costs might soon turn downward found small support for his views at the meeting of the American Public Works Association, held here last week.

Spokesmen for labor, the contracting industry, producers of materials and the engineering profession were in positive agreement on two points, namely that:

(1) There is little likelihood of costs going down—but they might even go higher; and

(2) Construction costs are not out of line with price trends throughout the national economy—in fact, they have not advanced as far or as fast as many other services or commodities.

This discouraging note, on which the 54th annual congress of the association opened, was dispelled in large part by the ego-building address of Dorothy McCullough Lee, mayor-elect of Portland, Ore. As commissioner of public utilities in her city, and with a background of 15 years service in the Oregon state legislature, she was well qualified to analyze municipal problems and to detail the importance of public-works men in providing many essentials of good living.

Also of special interest was on outline of methods used in conducting the municipal operations of Los Alamos, New Mexico under a private contract system.

Among the exhibits, major interest centered on a new type of refuse-collection body equipped with a crusher and continuous-loading device. Called the "Roto-Pac" by its developers, City Tank Corp. of Corona, L. I., it was claimed that the device would reduce and pack refuse to one-third of its original volume, thus tripling the payload which is normally afforded to a collector truck.

Another new refuse-collector body, equipped with three separate loading hoppers on each side was exhibited in model form by G. J. Duncan of Seatfle, Washington.

Cost and the consumer

Unanimity of opinion concerning the status of costs characterized a panel discussion in which the moderator, Maj. Gen. Philip B. Fleming, Federal Works Administrator, posed the question: "Are Construction Costs Too High?" He pointed out that price resistance already was being shown by the slow sale of new houses, in the hesitancy on the part of industrial firms to undertake building expansion programs, in the failure of highway construction to keep pace with demands and in the bogging down of public-works improvements.

In a blunt answer to General Fleming's rhetorical question, the consumer-member of the panel, Samuel S. Baxter, assistant chief engineer of Philadelphia. delivered an emphatic, "Hell, Yes!"

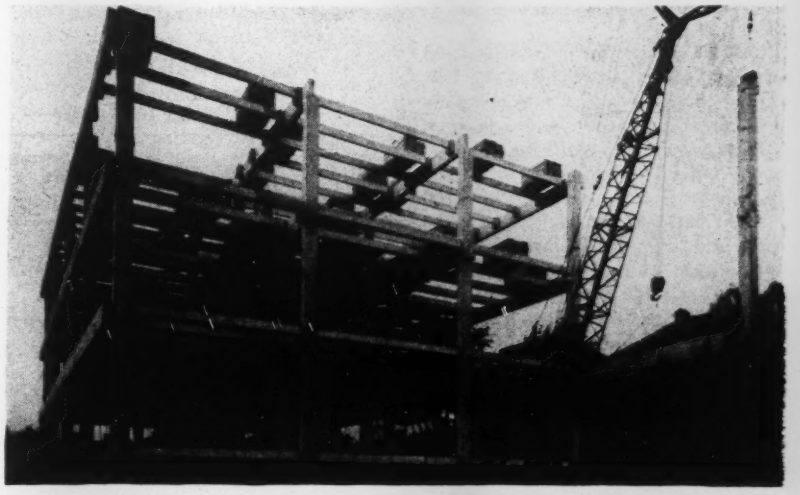
Pointing out that cities cannot pass on the increased cost of construction because their income is fixed by rather inflexible tax rates, Mr. Baxter cited these figures reflecting revenue income and construction costs: In the period 1940 to 1948, Philadelphia increased its revenue by 26 percent; construction costs in the same period, however, jumped 86 percent. "Small wonder," he concluded, "that public-works administrators think that construction costs are too high."

Labor and industry views

Here is what other members of the panel had to say:

Ernest A. Johnson, secretary-treasurer, Building and Construction Trades Council, Boston—Labor has a long memory. Back in 1932-36, when there was little construction, Boston labor was asked to take a 20 percent cut in wages. This they did, but they could receive no assurance from employer groups that such action would create more employment. They were told that wage rates were not the primary factor in construction volume. Increased volume was basically a matter of capital-investment opportunities coupled with the need for new facilities.

(*Continued on p.* 76)



FOUR STORIES PRECAST—Said to be the first wholly precast four-story structure in the world, this structure was recently completed by The Cemenstone Corp. of Pittsburgh, Pa. The concrete members all were framed with a ¼-in. tolerance. No adjusting or use of guy-wires was required in the erection.

NEWS BRIEFS

Industrial Construction — American Bakeries Co., plans a $1,000,000 plant at *Birmingham, Ala.* . . . Lion Oil Co. has signed contracts for a $1,250,000 sulfuric acid plant and a $750,000 ammonium sulfate plant near *El Dorado, Ark.* . . . American Gas & Electric Co. at a meeting of managers at *Wheeling, W. Va.*, announced that it will spend $500,000,000 on a 10-year plant and distribution program in its 7-state area. . . . Duquesne Light Co, *Pittsburgh, Pa.*, has announced a $2,500,000 program for dust control at three of its power stations and the Allegheny County Steam Heating Co. plant.

Bridges—The highway department of *Kentucky* has asked bids on construction of seven bridges in the eastern part of the state to replace structures to be covered by water backed up by Wolf Creek Dam. The bridges will be over Cumberland River and its tributaries. . . . Feasibility of a second bridge between *Louisville, Ky.*, and *New Albany, Ind.*, is being discussed by the Louisville Area Development Association.

Highways—The Department of Highways in the *District of Columbia* has asked for $4,263,542 to carry out seven major construction projects, including reconstruction of Military Road through Rock Creek Park. . . . It is said that *Ohio* will have $719,000,000 to spend on roads in the next four years. . . . The last section of the Sunset Highway which brings *Seaside, Ore.*, to within 79 miles of Portland, was opened to the public Oct. 8.

Public Construction—A $4,263,000 contract has been awarded to the List and Clark Construction Co. to complete the Corps of Engineers Benbrook Dam on the Clear Fork of the Trinity River, *Texas.* A flood control and water conservation project, the dam will be 9,200 ft. long and 130 ft. high above the stream bed. . . . H. E. Robinson, district manager of the Bureau of Reclamation, McCook, Neb., says he will recommend acceptance of the low bid of $10,301,653 for construction of Bonny Dam near *Hale, Colo.*, on the south fork of the Republican River. Utah Construction Co. was the bidder. . . . The $1,700,000 state Supreme Court building at *Tallahassee, Fla.*, is expected to be ready for occupancy next Jan. 1. . . . Harvard University, *Cambridge, Mass.*, is planning a new group of buildings—quarters for 600 graduate students and a dining hall for 1,000 students. . . . Plans are being prepared to insure construction by 1950 of Carney Hospital in *Boston, Mass.* . . . The federal and state governments will be asked to appropriate $6,000,000 for beach control on the peninsula at *Erie, Pa.* . . . Col. J. O. Killian, district engineer for the U. S. Engineers at *Albuquerque, N. M.*, has announced plans for a $2,500,000 military hospital at the Armed Forces Special Weapons project at Sandia Base. . . . Improvements at the state hospital at *Hollidaysburg, Pa.*, will cost $2,847,472. . . . Bureau of Reclamation has awarded a $13,348,419 contract to Peter Kiewit Sons Co., Omaha, Neb., and Morrison-Knudsen Co. Inc., Boise, Idaho, to complete the pumping plant for the *Columbia Basin's* irrigation system, the first part of the feeder canal and the 2 mg. reservoir. . . . The Corps of Engineers reports that J. W. Moorman & Son Co., Muskogee, Okla. entered low bid of $2,093,770 for work on the Lavon Dam project near *Dallas, Tex.* . . . On Dec. 15 bids are to be opened for a $4,000,000 science building and a $1,140,000 student health center at the University of Texas, *Austin.*

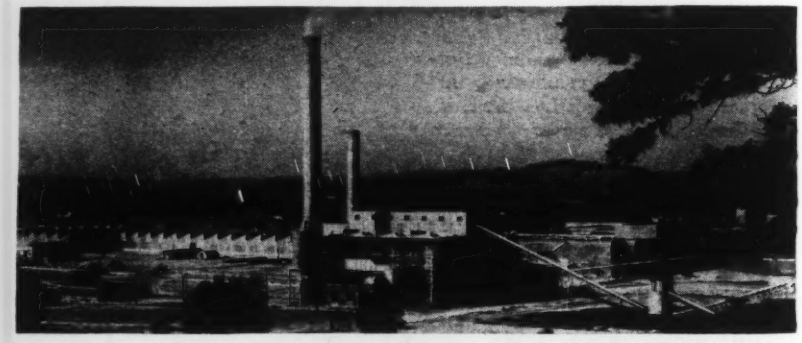
Housing—Plans have been filed for Dyckman Houses, a public project at the northern end of *Manhattan, N. Y. City.* The development will consist of seven 14-story buildings on a 14-acre site, to house about 3,720 persons. . . . Ironwood Village, Inc., a 166-unit rental project for Negroes at *Gary, Ind.*, has been approved by the Indianapolis office of the FHA. . . . To date, the Housing Authority of *Massachusetts* has approved 7,008 family units in 38 communities under the state-supported $200,000,000 program. . . . First 75 units of the 344 apartments in the Larchmont Gardens apartment project *Jacksonville, Fla.*, will be ready for occupancy Nov. 1. . . . Sub-standard dwellings on the east side of *Syracuse, N. Y.*, have been condemned and will be demolished. . . . Boosted by a veterans' housing program under which nearly $100,000,000 has been allocated for construction of almost 10,000 family units, the building industry of *Massachusetts* is likely to break all its records for production and expenditures in 1949, the State Board of Housing recently predicted.

Study closer world ties for engineering groups

At a recent meeting held in London, England, representatives of 15 organizations discussed means for getting closer cooperation between the principal engineering societies of the world. The conference was called by the three institutions representing the civil, mechanical and electrical engineers of Great Britain. The five major engineering societies of this country were asked to send their president and secretary to the meeting.

Ernest E. Howard, vice-president of the American Society of Civil Engineers, and Wm. N. Carey, secretary of the society represented the ASCE. Mr. Carey and Clarence E. Davies, secretary of the ASME, represented the Engineers Joint Council. There also were representatives from engineering societies in Belgium, Denmark, France, Holland, Norway, Sweden and Switzerland.

Discussions centered on developing means for a better exchange of information and closer cooperation on matters of joint interest without the cost of maintaining an international secretariat. According to the report of Mr. Carey to the Board of Direction of the ASCE at its Boston meeting, the group reached the conclusion that to be effective, any plan of international collaboration should be limited to a few top engineering organizations in large countries.



TENNESSEE VALLEY INDUSTRY grew with a bound when this $30,000,000 rayon plant went into production last summer. Designed and built by The H. K. Ferguson Co., it is one of the South's larger post-war developments. Here American Enka Corp. will product 10,000 tons of rayon yarn for tires annually.

U.S. engineering group to advise Iran on economics of rehabilitation scheme

Overseas Consultants, Inc., studies $650 million program aimed to balance Iranian economy—Technical feasibility already set

For probably the first time in history, a group of U. S. engineering firms will advise a foreign government on how much it should build and how much it should spend to rehabilitate its economy.

Signing of a contract last week by the government of Iran (Persia) and Overseas Consultants, Inc., of New York City, was the second step in a proposed $650,000,000 rehabilitation program planned by the middle-eastern nation.

First move was the preparation a year ago by Morrison-Knudsen International Corp., of San Francisco, of an 800-page report on the technical feasibility of the over-all program and its many components. Overseas Consultants will now review the economic feasibility of the plans, including financing, personnel problems, and availability of supplies.

A group of engineers representing the 11 firms making up the private organization will leave next month for Teheran, under the leadership of John R. Lotz, of Stone and Webster Engineering Corp., for a preliminary survey.

Comprehensive program

The announcement of the contract last week brought into focus one of the first over-all development programs to be proposed by the government of an admittedly backward nation, as Iranian officials attempt to bring their peculiarly unbalanced economy into a more stable relationship.

The program itself has caused considerable dissension among Iranians and others outside the country. An article in the August issue of *Fortune* magazine opposed it on the ground that grandiose "Little TVA" schemes are not the proper way to improve the economy of such a country. As recommended, however, the scheme bears little relationship to large-scale U. S. developments.

With a population of about 15,000,000 and a land area of 628,000 square miles, Iran is rich in money because of its vast oil fields, but has virtually no other industry, and its agriculture—through neglect of ancient irrigation systems and for other reasons—has been steadily declining. Its political system—which was a tight dictatorship until Reza Shah Pahlavi was deposed in 1941—has also contributed to the economic unbalance. Government ownership of virtually all existing industry, too, has had a stultifying effect on investment of new capital in small industries.

With this situation in mind, and with the objective of broadening the nation's economic base and lessening its dependence on outside sources for goods and services, the Iranian government shortly after the war called in the Morrison-Knudsen firm to survey hundreds of projects and recommend those that were technically possible.

Report lists jobs

The resulting report is a careful listing of such projects, with a theme of the necessity of building "from the ground up" running through it.

It recommends no hydroelectric power developments, for example, for immediate construction, urging instead the quicker and more flexible construction of steam or diesel power stations.

Three major programs for expenditure are included in this report, the biggest of them from a money standpoint being what amounts to a complete reconstruction of the 800 mi. of disconnected track that now constitute the Iranian State Railways. The U. S. firm urged a total expenditure over a period of years of about $157,000,000 for reconstruction, new trackage, rolling stock, completion of many jobs started but never finished, training of personnel.

Next largest would be the expenditure of about $135,000,000 for construction of steam or diesel power stations in the 44 cities with populations of 20,000 or more, to raise the national production of energy to 571,000,000 kwh. yearly.

Third is a $70,000,000 irrigation program, made up for the most part of small projects for river diversion, canal construction and drainage. The largest of these jobs would be an $18,000,000 diversion of the Kor River, 25 miles northeast of the city of Shiraz, where an earthfill and rockfall dam would store water. Many of the proposed projects actually would be reconstruction of ancient works, long discussed.

Highways—or at least passable roads—would call for expenditure of about $53,000,000; and about $40,000,000 would be spent for rice and grain elevators, refrigeration plants, canning plants, and similar work.

Calling attention repeatedly to the almost complete lack of data the report recommends the establishment of topographic mapping, surveying and similar bureaus; as well as agricultural experiment stations, and health centers.

Considerable work on the country's few ports and harbors is recommended, but no figures are appended as to cost; and it is suggested that about $8,000,000 be spent for airports—principally at Teheran and Abadan.

Recovery of natural gas as an additional fuel for industry is also urged in the first engineering report.

The engineers call attention to difficulties that will beset any such program: shortage of competent manpower, need for importing most materials and machines, inefficient governmental organization, and other matters.

Financing such a program is apparently possible. Iran now receives royalties from foreign oil companies amounting to about $35,000,000 per year, in addition to its revenues from taxes, sale of government lands and other sources.

Wide World Photo

"OPERATION ARMATURE"—Bringing this 178-ton fixture for a 149,000-hp. generator from Schenectady, N. Y., to San Francisco involved building a special 74-rubber-tire-wheeled truck. Here it is shown as hauled and pushed through San Francisco by five tractors.

Consultants reorganized

Formed in June, 1947, at the request of the U. S. government to survey Japanese industries, and dissolved in February, 1948, upon completion of that report, Overseas Consultants was reincorporated in August of 1948, with offices in New York.

It is headed by Clifford S. Strike, president of the F. H. McGraw Co., as president. Other officers are: Chairman of the board, John R. Lotz; treasurer, George V. T. Burgess; vice-presidents, Frank M. Carhart and Robert L. Hamill.

Participating firms are: Stone and Webster Engineering Corp.; F. H. McGraw and Co.; Coverdale and Colpitts; Standard Research Consultants, Inc.; Jackson and Moreland; The J. G. White Engineering Corp.; Sanderson and Porter; Madigan-Hyland; Ford, Bacon and Davis; Ebasco Services, and The American Appraisal Co.

Coast building officials endorse ASBO

Cooperation was the outstanding theme at all sessions of the 26th annual meeting of the Pacific Coast Building Officials Conference held recently in Sacramento, Calif.

This was the first meeting subsequent to the recent affiliation of this organization with the Building Officials Conference of America and the formation of the American Society of Building Officials (*ENR* Sept. 23, p. 1). Formation of the ASBO was promptly endorsed by the conference, and complete cooperation with the League of California Cities was announced as a major objective.

HHFA code unwanted

Among the resolutions passed by the conference was one provoked by an "increasing tendency on the part of the United States government to enter the field of building inspection under the assumption that local jurisdictions have set up barriers to inexpensive housing by means of building codes." Federal officials (more particularly the Housing and Home Finance Administrator, it was pointed out) are instructed under the housing act of 1948 to "conduct technical research and studies to develop and promote the acceptance and application of improved and standardized building codes and regulations . . . and methods for the assembly of home-building materials and equipment."

The resolution pointed out that this program "would contribute nothing in the national field of building code operation" and suggested that the Housing and Home Finance Administrator be requested to cooperate with the building officials organizations by using the existing codes and working in harmony with the existing building officials organizations.

Representative attendance

Attendance was representative of the cities operating under the uniform building code, which number about 500 in the United States. Conference membership is largely made up of architects, engineers and building officials engaged in interpreting and enforcing the uniform building code.

More than 300 changes have been submitted during the past year for incorporation in the new version of the code of ethics to be distributed to all volumes. Volume I will include the present code, with revisions; Volume II, which is essentially a new compilation, will be a book of uniform building code specifications.

Amendments to the conference constitution and by laws were designed to promote official cooperation of the PCBOC and the ASBO. Other constitutional amendments authorized the formation of chapters in the various states, territories, provinces and regions to serve local building officials.

Code changes

As indicative of the trend in code changes there were reductions in the number of requirements for use of the 4-hour, fire-resistant wall. Substitution in some cases was for the 2-hour separation. This change was explained as recognition of the fact that the objectives of building officials and the Board of Fire Underwriters are not always identical. A building code should be a series of minimum requirements, it was pointed out, rather than a law to provide good insurance risks.

Conference officers were all reelected for the ensuing year and three new members of the executive board were elected for a three-year term. The complete official roster is now as follows: President, Harold O. Rasmussen, chief building inspector, Santa Ana, Calif.; first vice-president, Wm. C. Clubb, city engineer, Eugene, Ore.; second vice-president, A. W. Russell, building inspector, San Mateo County, Calif.; executive board members, Northern Section, Vernon Thorpe, city superintendent, Tacoma, Wash.; Central Section, Ralph G. Hitchcock, building inspector, Salinas, Calif.; and Southern Section, Col. Wm. J. Fox, chief engineer, Los Angeles County Department of Building & Safety.

Georgia suit endangers state road contracts

Georgia political leaders last week studied possible counter moves to meet the threat of a court injunction that has already halted a $10,000,000 state road building program. A suit, brought by four taxpayers, alleges that all contracts let since Aug. 3 are illegal and void since they violate a state law which prohibits the letting of contracts within 90 days of the ending of a governor's term of office.

The taxpayers have asked an injunction to end work on which contracts have been signed. Acting Gov. M. E. Thompson who had planned to relinquish his office in November by calling a special session of the legislature following the general election is now considering remaining in office until Jan. 12 so as to validate most of the highway contracts now let and on which work is in progress.

The suit is to be heard on November 3 in Cuthbert, Ga., at which time decision is expected on the ruling of Attorney General J. E. Cook that Governor Thompson was not bound by the 90-day period rule.

Paul Andrews, secretary of the Georgia Contractors' Association, pointed out that the injunction would cost the state between $5,000,000 and $6,000,000 and throw about 3,000 persons out of employment. Highway department officials predicted that contractors would sue the state for their expenses and losses on work.

Armed forces spending $23 million in Hawaii

More than $23,000,000 will be spent by the armed forces on construction projects in Hawaii during the current fiscal year.

The Army will spend $16,000,000, including $7,000,000 for repairs and alterations, $1,160,000 to start a new national cemetery in Punchbowl Crater, Honolulu, and the rest for new construction including theater and residence facilities at various posts.

The Navy's $5,643,000 program contemplates increased water supply, improved radio facilities, fire protection and waterfront lighting. Other improvements may be undertaken if additional funds become available.

The Air Force will spend $1,500,000 on a 500-seat theater, two swimming pools and the rehabilitation of a Hickam Field barracks damaged in the Pearl Harbor attack.

Non-subsidy housing bonds sold by New York City

On Oct. 18 the New York City Housing Authority executed the first financing of its planned $200,000,000 program of non-subsidy housing by selling $48,256,000 of bonds maturing in three to fifty years. The bonds were bought by a syndicate of 126 banks and investment bonuses at an interest cost of 3.213 percent.

The security includes the unconditional guarantee of the city and a reserve fund for maintenance.

It is said that this is the first time that public housing bonds have been sold by a public body without cash subsidy backing.

The housing projects covered by this financing are known as the Pelham Parkway, Gun Hill, Dyckman and Todt Hill houses.

Atomic wastes seen top disposal task

by J. Roland Carr and J. C. Bumstead

Detroit—Sanitary engineers face their biggest challenge and greatest opportunity in treatment and disposal of the many and complex sewage wastes being produced today.

Such wastes, according to speakers at the 21st annual meeting of the Federation of Sewage Works Associations, held last week, stem from two major sources—expanding nuclear-fission operations, and a wide variety of new products manufactured by private industry.

Emphasis on stream-pollution abatement also predominated throughout the four-day conference, which attracted more than 600 sanitary engineers and sewage-works superintendents.

AEC engineer speaks

A broad picture of what will be expected of the sanitary engineer in the atomic age was presented by Arthur E. Gorman, sanitary engineer of the Atomic Energy Commission, in a paper co-authored with Abel Wolman, consultant to the commission.

After pointing out that training of young engineers in basic principles of nuclear physics is a most important responsibility of the sanitary-engineering profession—in much the same manner as he addressed the American Water Works Association last spring (*ENR* May 13, vol. p. 685)—Mr. Gorman went on to describe some of the problems of radioactive-waste disposal.

"It is well known," said Mr. Gorman, "that the AEC has developed effective methods of protection against radioactive contamination both in-plant and on-site in the past." More recently, he said, attention has been focused on off-site problems that develop when wastes from nuclear-fission operations are released to the atmosphere, into streams or the ground, or deposited on the surface of the earth.

Some measure of comfort was secured from Mr. Gorman's assertion that the AEC is striving for a permanent solution of its waste-disposal problems. "One of the commission's foremost objectives," said he, "is that this new industry of nuclear fission can be expanded to meet this country's needs without creating objectionable or hazardous conditions in the vicinity of its plants."

Training for sanitary engineers

A small group of sanitary engineers in federal agencies, other than the AEC, are being trained at Oak Ridge, Tenn. and Los Alamos, New Mex. in nuclear physics and its application to atomic energy problems. Subsequently, it is planned to provide this training for sewage- and water-plant superintendents and public-health officials.

There is a definite parallelism between nuclear-fission waste disposal, whether in production or research, and disposal of wastes from chemical or metallurgical industries, continued Mr. Gorman. Thus, many well-established methods of sewage disposal are applicable to this new industry but are subject, however, to peculiar properties of radioactive materials and special procedures and precautions which must be followed in processing them, he concluded.

Chemical wastes vs. pollution

To determine the nature and extent of the need for diverting its wastes from public waters, the chemical industry is participating in stream-pollution surveys. Close cooperation is essential, Raymond Hess told the conference, because high costs of corrective measures necessitate establishment of a "sound relation between pollution characteristics and uses of receiving waters." Mr. Hess is head of pollution research and operating improvements, National Aniline Division, Allied Chemical and Dye Corp., Buffalo, N. Y.

ENOCH R. NEEDLES, partner in the consultant firm, Howard, Needles, Tammen and Bergendoff, has been nominated for the 1949 presidency of the American Road Builders' Association. His present firm, specialists in fixed and movable bridge design, has worked on the Maine Turnpike, the Delaware River Bridge at Wilmington and numerous railway and state projects.

The chemical industry, he declared, doubts the significance of standard methods for analysis of pollution and its effect on receiving streams. In particular, it is felt that the biochemical-oxygen-demand determination leaves much to be desired. Mr. Hess said that short-cut methods using oxidizing chemicals, such as permanganate, dichromate, iodic acid and chlorine, provide no generally constant relation to BOD.

A considerable number of papers delivered at the conference, which was held in conjunction with the 23rd annual meeting of the Michigan Sewage Works Association, dealt with specific problems of sewage treatment and research throughout the country.

Notable throughout the meeting was the absence of any comments or discussion on the cost of construction of sewage-works facilities, financing or availability of construction materials. A great deal of interest, however, was displayed in new sewage-treatment equipment and allied products shown by 26 manufacturers who held displays in conjunction with the conference.

Award winners and new officers

Presentation of 1948 awards and honors was made at the annual banquet. The Harrison P. Eddy Award—for outstanding research in sewage treatment—went to F. W. Kittrell and O. W. Kochtitzky, Jr., sanitary engineers, Tennessee Valley Authority, Knoxville.

The George Bradley Gascoigne Medal—for an outstanding contribution to the art of sewage works operation—was awarded to David P. Backmeyer, superintendent, Marion (Ind.) sewage-treatment plant.

Leroy W. Van Kleeck, State Department of Health, Hartford, Conn., received the Charles Alvin Emerson Award for long and devoted service to the federation. Honorary membership in the federation was conferred on F. Wellington Gilcreas, assistant director, division of laboratories and research, New York State Department of Health, Albany, N. Y.

V. M. Ehlers, chief sanitary engineer, Texas State Department of Health, was elected president of the FSWA, succeeding George S. Russell, consulting engineer of St. Louis, Missouri. Mr. Ehlers was unable to attend the conference due to illness. A. H. Niles, superintendent of the Toledo (Ohio) sewage treatment works, is the new vice president, and W. W. DeBerard, city engineer, Chicago, was re-elected to his eighth term as treasurer. Carl E. Green, consulting engineer of Portland, Ore., was named the new director-at-large, succeeding Harold F. Gray, sanitary hydraulic engineer of Berkeley, Calif.

Public Works Congress sees costs staying up

(*Continued from p.* 71)

If wage rates were not an important factor in construction volume in 1932, why should so much stress be laid on this factor today, argued Mr. Johnson. Then he asserted that the path to lower construction costs could be found by striving to make more efficient an industry that was by its very nature wasteful in its use of man-power.

High hourly wage rates were justified by Mr. Johnson because construction workers had no security in steady employment. He said it should not be forgotten that "building-trades workers are paid by the hour, but they must live by the year."

H. E. Foreman, managing director, Associated General Contractors of America, Washington — Construction costs have risen less than the cost of commodities in general. While the Bureau of Labor Statistics Wholesale Commodity Index has increased 112 percent since 1939; the construction-cost index of the AGC shows a rise of only 72 percent.

Unless there is an economic catastrophe, construction costs can be expected to decline only gradually through the development of new methods of work, more efficient design of structures, greater productivity on the part of labor and from greater mechanization, said Mr. Foreman.

Operating conditions for general contractors would be greatly improved by a return to firm price quotations on supplies and to firm delivery dates. There has been some improvement, but much remains to be done, particularly in obtaining firm prices on steel and cement.

Melvin H. Baker, president, National Gypsum Co., Buffalo — Building-materials prices are higher than they were in 1947, but they are well within the level of our present-day economy. The fact is that the average wholesale prices of all these materials, with the exception of lumber, increased only 68 percent from 1939.

"However", said Mr. Baker, "we are faced with the cold fact that costs are still advancing, which foretells higher prices yet to come". Some of these increases reflect high taxes, others relate to higher wages and freight rates that are up from 50 to 100 percent, as well as advances in fuel and power costs.

There are indications that production is catching up and that inventories in retail trade channels are increasing. This points to restoration of competitive forces that will bring into action greater economies and, in some cases, more normal profit-taking. All of this may bring a reduction in prices. But do not expect too much from this, concluded Mr. Baker.

Harrison P. Eddy, Jr., consulting engineer, Boston—While high wages are basically the reason for high construction costs, an economic depression will not necessarily mean lower wage rates. During the last depression it will be remembered that on public-works construction sponsored by the federal government, it was stipulated that local prevailing wage rates be maintained. There is no reason to believe that this principle will or should be abandoned.

The answer to the question, "Are construction costs too high?", said Mr. Eddy, is no—except for those whose incomes are fixed. Many organizations and individuals, however, have increased their income by virtue of the higher level on which our economy is operating, and for them, construction costs are not out of line.

A woman's viewpoint

"What marvelous things public-works men do—and what wonderful things they could do if they had more money". It was with this flattering and sympathetic statement that Dorothy McCullough Lee, began her address on a women's view of the place of public works in cities.

Mrs. Lee, with her background of legislative and administrative experience on both state and local levels of government, had more than charm to substantiate her viewpoint. She pointed out that throughout the nation our cities were "on their uppers" so far as finances were concerned. This situation results from the fact that people in cities are not properly represented in state legislatures, which are dominated by rural interests.

"Both authority and revenue are being taken from cities by higher levels of government, and this has been going on for a generation", asserted Mrs. Lee. To stop this trend much missionary work is required. And very importantly, municipal administrators must seek the means to translate to the public, in simple terms, the needs of the city. Unless the public is informed and becomes articulate, organized pressure groups will continue to dominate and defeat efforts toward unselfish civic betterment, concluded Mrs. Lee.

Municipal work by private contract

Operation of a municipality—Los Alamos, New Mexico—by private contract, was described by Arthur B. Allen, director of the public works division of The Zia Company. The company, which holds a general contractor's license in New Mexico, was organized by Robert E. McKee, well-known contractor in the southwest.

Los Alamos is one of the installations constructed by the Manhattan District of the Corps of Engineers that has since been transferred to the jurisdiction of the Atomic Energy Commission. The Zia Company received its first contract to assume operation of the townsite and adjacent facilities in 1946. Since then, the original contract for a one-year period has been extended twice. Today it has a three-year renewal to June 1951.

The contract is on a budgeted-cost plus fixed-fee basis, subject to periodic re-negotiation. While the Atomic Energy Commission establishes controls for basic operating methods, there is wide latitude extended to the company management for every-day procedures. Contract cost and fee details were not revealed. It was stated, however, that costs have been lower than those under Army post-engineer operation. Also, it was noted that when sub-contract bids were sought on refuse disposal, all of them were higher than the cost of The Zia Company.

For operating this community of 12,000, The Zia Company employs 3,000 people, some 350 of which are detailed to the public-works department. In explanation of why such a large number of operating personnel was needed, Mr. Allen said that "the answer is complex". He pointed out, however, that the company is charged with some 46 general duties varying from maintenance of 2,611 buildings, through all types of orthodox public-works functions, and including also the management of concessionaries, a veterinary hospital, nursery school, the local radio station and other services.

Officers and directors

Elected to succeed J. W. Morgan, commissioner of public works, as president of the American Public Works Association was William A. Xanten. Mr. Xanten, superintendent of the division of sanitation, Washington, D. C., is internationally recognized as an expert in street-cleansing methods.

New vice presidents are: Robert L. Anderson, superintendent of public works and village engineer, Winnetka, Ill., and W. A. Gayle, city commissioner of Montgomery, Ala.

New directors are: Milton Rosen, commissioner of public works, St. Paul, Minn., and William Foster, engineering editor, *The American City*.

Donald F. Herrick, executive director of the association, reported that membership was now at a new high of 1,534. Convention registration of 535 likewise was a record. Exhibitors of public-works equipment totalled 55.

OBITUARY

B. A. Marburger, 66, former professor of the civil engineering department of Texas A. and M. College, died at College Station, Tex., Oct. 10. He served at the college for 28 years, having retired two years ago. He did railroad research work and at the time of his retirement was head of the buildings and college utilities which position he had held since 1930.

Roy H. Hose, 63, civil engineer of Rochester, N. Y., died Oct. 14. He was a member of the city engineer's staff for 19 years prior to opening his own office.

Thomas A. Lane, 31, New Bern, N. C., civil engineer, was killed Oct. 13 in an automobile accident near Keysville, Va. A Naval Reserve officer in the Civil Engineer Corps, he was engaged in construction work at the Marine Air Station at Cherry Point, N. C., during World War II, and recently had been an engineer with the Civil Aeronautics Commission. A native of New York City, he was with the Consolidated Edison Co. prior to the war.

Albert F. Krause, 73, former senior partner in Albert Krause's Sons, construction engineers, of Buffalo, N. Y., died recently in Lower Lake, Calif. He was a graduate of Rensselaer Polytechnic Institute. After serving with the New York State Department of Public Works and the U. S. Geological Survey, Mr. Krause became a partner in the company which was founded by his father.

James B. Vernon, 90, former Huntington, Ind., city civil engineer, and Huntington County surveyor, died Oct. 12 in Medford, Ore. He retired from the city engineer post last Jan. 1.

Ivan R. Ault, 60, former engineer of Division 3 of the Ohio Highway Department at Ashland, died Oct. 13 in Lexington, Ky. He had served as chief maintenance director and director of the Ohio Highway Department. His last position was with the U. S. Engineers at the Cleveland Airport.

William C. Fuller, 42, engineer with the Federal Works Agency for 11 years, died Oct. 13 at Washington, D. C. He went to Washington about 19 years ago and worked for private construction firms before he began his government service. He was a construction engineer for the Public Buildings Administration and during World War II worked on defense housing. For the last few years he had been in the Plans and Specifications Branch of the Repairs Section of the PBA.

Jacob Barab, a consulting engineer of Avondale, Pa., died Oct. 9 at Atlantic City, N. J. He had been associated with the Hercules Powder Co. of Wilmington, Del., for 22 years before he organized the Kelbar Powder Co. at Avondale in 1939. He headed the latter company until 1945, when he became a consulting engineering in New York City and Lakeland, Fla.

Joseph C. Gibbs, 60, a civil engineer and a district surveyor for the Philadelphia Bureau of Surveys and Engineering, died Oct. 12. He attended the Drexel Institute of Technology and was a former secretary of the Society of Municipal Engineers.

Daniel Webster Mead, 86, retired professor of hydraulics and sanitary engineering, University of Wisconsin, died Oct. 13.

N. H. Roland Yuhlin, 41, civil engineer, and head of an engineering firm bearing his name, died Oct. 15 in Natick, Mass. He was a graduate of Northeastern University.

J. F. MacKenzie, 58, division engineer for the Canadian National Railways at Edmundston, N. B., for the last six years, died Oct. 18. He had been on the engineering staff of the railroad continuously since 1914 except for two years' service in the Canadian army.

George E. Low, 75, of Bradford, Vt., a retired consulting engineer for New York City from 1895 to 1901, died at Brattleboro, Vt., on Oct. 22. He had been president of the Low, Parker Engineering Co., New York. A specialist in foundation and structural work, he was retained by owners of property adjacent to Grand Central Terminal when the underpasses for trains were cut through.

George L. Borden, 55, a consulting engineer, died Oct. 19 at Natick, Mass.

Cornelius P. Mahoney, 47, manager and chief engineer of the Palo Verde Irrigation District, Blythe, Calif., for 19 years, died at San Diego Oct. 17.

CONSTRUCTION ACTIVITY

CONTRACT VOLUME

Continental U. S. Only
(Millions of Dollars)

	Week of Oct. 28 1948	Cumulative 1948 (44 wks.)	Cumulative 1947 (44 wks.)	% Chge
Federal	$25.1	$825	$524	+57
State & Mun.	50.6	2,233	1,486	+50
Total Public	$75.7	$3,058	$2,010	+52
Total Private	103.4	2,867	2,671	+ 7
U. S. Total	**$179.1**	**$5,925**	**$4,681**	**+27**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

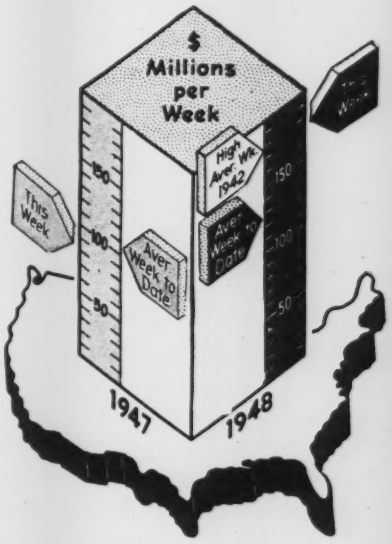
Dollar Volume (Millions)

Type of Work	This Week	Cumulative 1948 (44 wks.)	Cumulative 1947 (44 wks.)	% Chge
Waterworks.	$1.3	$169	$93	+82
Sewerage ..	13.2	194	116	+67
Bridges	9.5	244	162	+51
Highways ..	13.7	872	685	+27
Earthwork, Waterways.	6.6	440	250	+76
Buildings, Public	27.5	949	495	+92
Industrial .	62.0	948	752	+26
Commercial	36.4	1,565	1,559	+ 0.3
Unclassified.	9.0	544	569	— 4

NOTE: Minimum size projects included are: Waterworks, and waterway projects, $28,000; other public works, $50,000; industrial buildings, $68,000; other buildings, $250,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1948 (44 wks.)	Cumulative 1947 (44 wks.)	% Chge
NON-FEDERAL ..	$3,857	$2,026	+ 90
Corporate Securities	1,825	782	+133
State and Municipal	1,540	996	+ 55
U. N. Building Loan	65	....	....
Fed. Aid Highway	427	248	+ 72
FEDERAL	1,559	819	+ 91
**Total Capital ..... **	**$5,416**	**$2,845**	**+ 90**



As Reported this week to...
Engineering News-Record

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	Oct.'48	480.21	230.84
Building Cost	Oct.'48	357.07	193.02
Volume	Oct.'48	291	128

EDITORIALS

VOLUME 141 NUMBER 18

October 28, 1948

Cutting Construction Costs

NO MAJOR CHANGE in the index of construction costs is going to occur as a direct result of the publication of the articles in a special section of this issue, despite the valiant efforts of the little man in the sketch on the cover. But recognition of that fact in no way detracts from the value of the articles. Each tells how costs have been cut on specific jobs or in certain types of operations. As a result, the continuing rise in construction costs has had less effect on the bank account of the builders of the structures that are described than would have been the case had not the skill of the individual architect or engineer been applied to finding ways to save a dime here and a dollar there on the job in hand. Thus, the articles can serve a useful purpose if they stimulate others to seek savings on their own jobs. Too many people today are bemoaning the scarcities of materials, high labor costs, low labor productivity and the throttling effect of antiquated building codes, and too few are asking themselves "What can I do to cut costs *on this job?*". If these articles serve to set more engineers and architects thinking along those lines they will be well worth the time the authors and editors put into preparing them.

Sense on Stream Pollution

TIMELY ADVICE on stream-pollution policy was given sanitary engineers at the recent ASCE convention in Boston. It is that economics must be coupled with common sense if stream pollution cleanup is to get anywhere. This advice came from Thomas R. Camp, consulting engineer of Boston. Neither the pressure groups interested in sports and wild life, who want pristine pure streams, nor the rugged industrialists, who claim unrestricted use of streams for waste disposal, are being reasonable, said Mr. Camp. Both must give way from their extreme positions, and it is up to sanitary engineers, both as private consultants and public employees to provide them with a yardstick. Mr. Camp sees this yardstick as a standard of water qualify for each stream, or a specific reach thereof, set in accordance with the amount and kind of pollution that can be allowed in view of the required uses to which the stream and its water must be put. There is no single water-quality standard for a stream any more than there is a single type of foundation for every building site. There is no single classification into which streams can be put any more than there is a single zoning standard that can be applied to a whole city. Once a rational stream-pollution policy is adopted, all attention and energy can be directed to methods of treatment and methods of fair allocation of costs. These are the significant questions—not whether there should be 100 percent cleanup or none.

Know Your Costs Currently!

AT THIS SAME ASCE MEETING, in the Construction Division session, a paper on cost control was given that would bear careful reading by every construction contractor. Presented by R. H. Heitman, chief engineer, Western Contracting Co., Sioux City, Ia., it focused attention on the basic requirement of any cost system—that it reveal costs currently. To do this, accounts should be set up to correspond with the items in the estimate and in the bid. And all applicable charges must be posted to these accounts currently, including equipment costs as well as those for labor and materials. Now more than ever, effective cost controls are the badge of successful contracting, and this session of the ASCE Construction Division provided further proof of positive actions being taken to improve cost accounting methods. Kenneth W. Markwell, assistant commissioner, described how the Bureau of Reclamation is setting up its accounts to correspond to items on the bid schedules, and H. P. Maxton, Raymond Concrete Pile Co., reported progress on the Construction Division cost manual. It was a well-planned and presented program. If more societies and associations would attack the cost problem on the same practical basis, the day of blind cost keeping with only checkbook entries would be over. Perhaps lower costs could be achieved on construction, and certainly fewer contractors would go broke.

Running Cities By Contract

CAPTURING SPECIAL INTEREST at the American Public Works Association meeting in Boston last week was a description of municipal administration under private contract. As told in the news pages of this issue, Los Alamos, New Mexico, an

Atomic Energy Commission community of 12,000, is being managed by a contractor on a budgeted-cost-plus-fixed-fee basis. Unfortunately, the paper dealt largely with the physical functions of the contractor and gave virtually no information as to what the costs might be. Admitting, of course, the difficulties of making cost comparisons of municipal operations, nevertheless, it would be of extraordinary interest to get some yardsticks of private versus public operation of, at least, some local government functions. It is to be hoped, therefore, that the Atomic Energy Commission may find it feasible and not incompatible with security regulations to provide cost information from Los Alamos, if on nothing more than the public-works operations. Here is an actual demonstration of private-enterprise management in a field that has always been influenced by local political considerations. Can a contractor, whose existence is conditioned on making a profit, provide more efficient municipal service at lower cost than can be obtained under orthodox methods of public operation? Our cities would like to know.

Interest in Conservation Rises

SOME OF THE SCIENTISTS assembled recently in Washington for the centenary of the American Association for the Advancement of Science portrayed a gloomy future for the world. They saw population expanding rapidly to the point where the world no longer would have enough arable land to feed all its people. And this despite all that science can do to make two blades of grass grow where only one grew before.

That conclusion of the scientists is not new. It has caused concern to many people in the past who tried to foresee the ultimate effect of the wasteful use of natural resources that they found all about them. But they were too few in number to be heard, and the waste went on.

Today the situation appears to be changing. In addition to what was said in Washington, two new books on the same subject are being widely read: "Our Plundered Planet" and "Road to Survival". More recently the same subject was discussed over radio networks carrying the forum of the New York *Herald Tribune*. And this week the American press carried extended accounts of a new 15-year plan of Russia to reclaim and develop her land for agriculture. Thus it appears probable that public opinion may be aroused to the point of calling for more definite legislative action on conservation than has been taken in the past.

Engineers must play an important part in such an expanded program for conservation of natural resources. For years past they have been active participants in irrigation, water power development, flood control and the storage of water for domestic use. All of these fields of conservation have greater possibilities for refinements and extension, to which engineers should be directing their best thinking. In irrigation work, for example, much water still is wasted and much soil is being permanently damaged due to lack of knowledge of how to deal with alkali in the water.

From the viewpoint of conservationists, the sanitary engineer could inspire many helpful measures. For example, in all but a few areas, organic matter in sewage sludge and garbage that should be going back to the land is wasted by dumping or burning. Similarly, in arid regions where water is at a premium, the water component of sewage might be more effectively processed for re-use.

Much the same can be said about flood control. Most of what was done in the past in the way of levee and reservoir construction was necessary, but again, from the viewpoint of long-range conservation, too little has been accomplished in reducing flood flows at their source by reforestation, contour plowing, terracing, and check-dam construction. These all have the added advantage of preventing erosion of precious soil while saving water.

Obviously, engineers cannot overlook the cost of conservation measures. Many proposals that appear highly desirable from a long-range conservation viewpoint will be found to be uneconomic from the viewpoint of the public official who has to meet today's financing and operating costs. But this condition should not keep engineers from striving to find solutions that will give the greatest practical amount of conservation, or from advocating conservation measures that will be more costly than a simpler but more wasteful operation. Aroused public opinion may compel public officials to adopt conservation measures that would not otherwise be approved.

ENGINEERING NEWS-RECORD
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A RUBBER-TIRED DOZER could do as well on this job provided rain did not create soft and slippery going.

Fitting Earthmoving Equipment to the Job

E. A. Braker
Superviser of Sales Engineering, Industrial Power Division,
International Harvester Co., Chicago

FROM the contractor's viewpoint, efficiency of earthmoving equipment depends upon its adaptability to his particular needs. Looking elsewhere for information when making an equipment purchase is a mistake. A keen study of job requirements will indicate which equipment features are most desirable, and an earthmoving machine that provides these features is the logical choice.

There is no "superior" type of earthmoving equipment. Superiority, when it does exist, is interwoven with specific job conditions, and may disappear quickly when these conditions change. It approaches the impossible to design earthmoving equipment which will perform with top efficiency on all types of work. Work conditions vary too greatly. Design features which are highly desirable under one set of conditions, may be useless or even detrimental under other conditions.

The builder of earthmoving equipment is faced with two possibilities—he may produce a specialized machine which will work with peak efficiency on specialized jobs, or a more versatile machine which will work with acceptable efficiency on many jobs. Choice between the two depends on the type and scope of the work to be done.

Specialized or versatile machines

In general, large rubber-tired, self-propelled earthmovers are representative of the specialized equipment, while crawler tractors with various equipment are representative of the more versatile class. It is logical that crawler tractors with scrapers cannot compete with the efficiency of specialized rubber-tired units on long hauls, and just as logical that rubber-tired units cannot compete with the versatility of crawler tractors and their equipment on many earthmoving jobs connected with general contracting work.

When all job factors are considered, it is stretching the point to say that rubber-tired earthmovers and crawler tractors with equipment are competitive. There is some overlap in the types of work they can do—a few jobs where one can perform as well as the other—but these occasions are too few to arouse a controversy. Even when controversy exists, a survey of other job requirements will usually settle the issue.

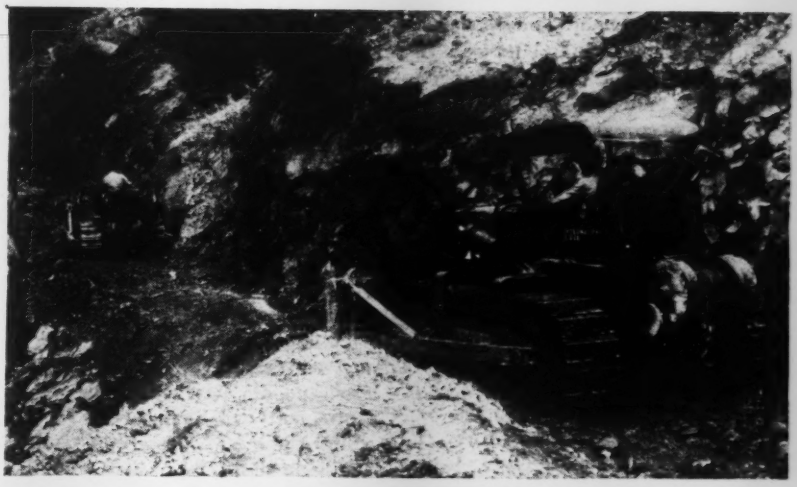
The contractor whose earthmoving operations are extensive enough to afford specialized equipment for each job is not usually interested in the versatility of a machine. The majority of contractors who must fit each machine to several jobs regard versatility as a highly important feature. They find no tailor-made answers to their equipment problems. Specialized equipment which would serve

them well today while making long hauls, might stand idle tomorrow when the job calls for excavating work in rain-soaked clay. The high speed of rubber-tired prime movers, their outstanding contribution to earthmoving, might be made useless by extremely short hauls, or by the necessity of dressing the haul road during each return trip. These contractors cannot base their equipment purchases on immediate job requirements, for the next job may have entirely different working conditions.

The general construction contractor, the man who is faced with a wide variety of earthmoving jobs during the span of his equipment's life, must use sound judgment, past experience and foresight before he signs the equipment purchase order. All conditions connected with the purchase and use of the equipment must be studied and weighed. A suggested list of factors to be considered include:

1. Cost of owning equipment.
2. Cost of operating equipment.
3. Working conditions, both current and anticipated.
4. Climate of operating area.
5. Service facilities available.
6. Contingencies.

Analysis of these factors will provide dependable information to use in buying power and equipment.



NEITHER SPEED NOR RUBBER would be adaptable to this precarious mountain road-building job where sharp rocks predominate.

A CRAWLER TRACTOR is at a disadvantage on this type of work because of its slower speed. But if the contractor's next job may be brush clearing and leveling, sacrifice of some efficiency here is not important.

Confusing price and cost

Purchase price and the cost of owning earthmoving equipment should not be confused. It is more logical to regard purchase price as an investment, while cost of ownership is based on the work-hour depreciation rate. Total depreciation of earthmoving equipment is usually based on a four, five, or six-year period, dependent on the industry in which the equipment is used. The number of hours that equipment is operated within this depreciation period determines the work-hour depreciation rate, and thereby the cost of ownership. It is apparent that equipment which is sufficiently versatile to be kept busy will have a lower work-hour depreciation rate than specialized equipment which will stand idle a part of the time.

Cost of operating equipment includes more than fuel, oil, servicing and repairs. These common expenses will remain fairly constant regardless of the type of equipment used. When expenses are incurred which contribute directly to the benefit of specific equipment, they are a logical charge against that equipment's operation.

Thus when earthmoving equipment must be pushed during loading, the cost of pushing is an operating charge. When one type of equipment demands a better haul road than others, the extra expense of haul-road maintenance must go against equipment operation. These are not job overhead charges—they are direct costs of operation that would not be incurred if another type of equipment were used. They may be justified by increased efficiency, but make certain that this is the case.

Selecting of types of equipment

The kind of earthmoving work to be done, more than any other single factor, will influence the type of equipment to be purchased. This is particularly true in connection with large jobs where specialized equipment fits nicely into the picture. For small jobs, the contractor cannot solve the problem so easily. His equipment must be sufficiently versatile to tackle many kinds of work. He

must recognize that certain specialized equipment is hampered by absolute limitations, while more versatile equipment can cope with a number of different operations.

To illustrate, a contractor with a fleet of rubber-tired, self-propelled earthmovers would be stymied on a job where slippery loading and hauling conditions prevailed. He would find it difficult if not impossible to use such equipment on many small excavating jobs, on smooth frozen ground, on ice, or in swampy areas where maximum weight distribution is necessary to keep from bogging down. On the other hand, the more versatile crawler tractor can work under all these conditions, and, in an emergency, do any work the rubber-tired equipment can do. It may not handle specific jobs so efficiently, but it will get all of them done.

From job studies, figures are available which suggest the most efficient earthmoving equipment for hauls of various distances.

These figures are: Haul distances up to 300 ft., tractor-mounted bulldozers; 300 to 1,000 ft., crawler tractors and scrapers; haul distances over 1,000 ft., high-speed rubber-tired units.

The last figure, of course, presupposes conditions which are favorable to rubber-tired units. On rough or steep terrain with poor underfoot conditions, the crawler-scraper units might be more efficient up to 1,500 ft. and over. The new high-speed crawler tractors now available, with speeds ranging upward to 7.8 miles per hour, offset to a large extent the extreme speed advantage formerly enjoyed by the rubber-tired units.

In selecting the type of equipment for any job, prevailing weather conditions in the operating area must be taken into consideration.

Ease in servicing

Every contractor recognizes the importance of convenient and nationwide service facilities for the equipment he owns. The ability to get parts and service quickly when needed is of prime importance in keeping equipment constantly on the job. Down-time for repairs is a dead loss, and often tying up one pice of equipment will hamper other operations. The quality of service facilities available should be investigated. Are the servicemen properly trained? Have they had extensive experience? Do distributors or dealers stock spare parts, or must they be ordered from the factory?

Contingencies in connection with the purchase of any specific type of earthmoving equipment include dangers which may or may not become real. Sound judgment and foresight must be used to uncover such possibilities. For example, new types of equipment on the market are liable to show design defects which must be corrected in later models. Therefore, the danger of early obsolescence must be taken into consideration. Lacking a backlog of extended field service conditions, the overall efficiency of new designs is difficult to forecast.

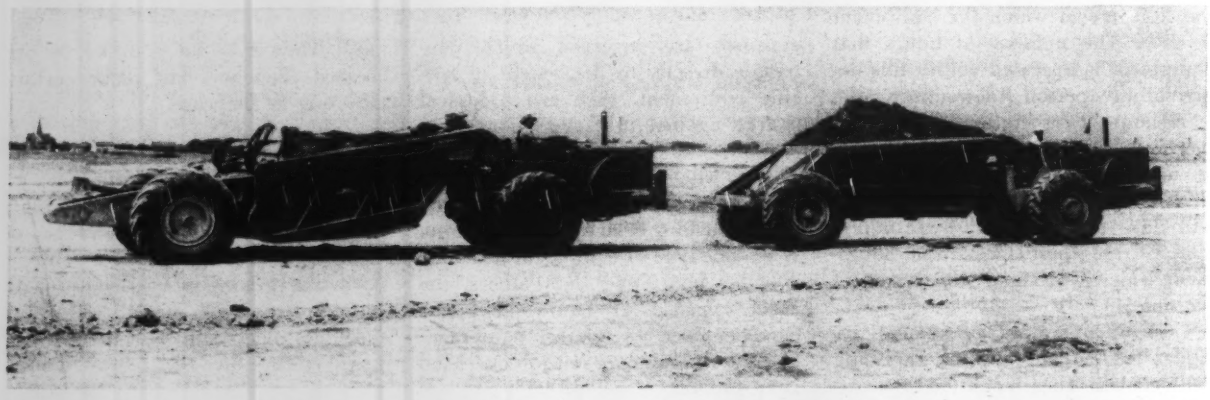
The overhead costs and hourly operational costs of tieing up $30,000 in a piece of equipment that can be used only three or four months out of each year are obvious. There is also a hazard in buying a large earthmover to do the work of several smaller units, or in buying specialized equipment on the assumption that all future work will be specialized.

When too much dependency is placed on a single large unit, an unexpected breakdown may bring the entire job to a halt. Smaller units will reduce this hazard. It is not advisable to put a specialized machine on work for which it is not intended. And working a machine beyond its practical limitations may cause excessive wear and down time.

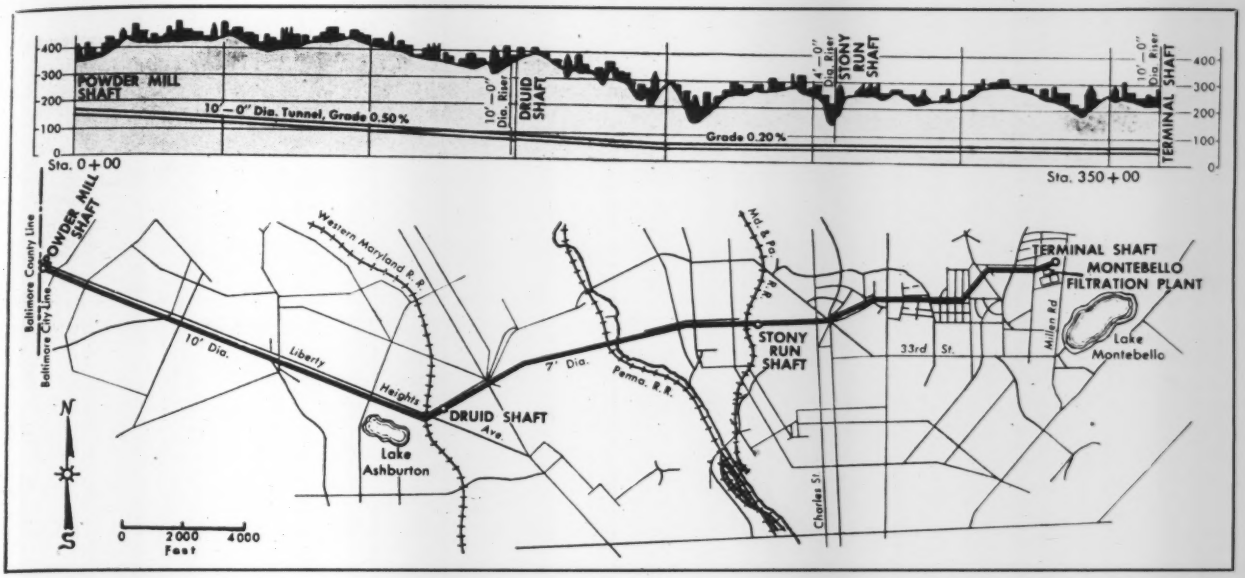
Contractors should not make the mistake of comparing old equipment of one type which they have used for several years with new equipment of another type which has just appeared on the market. This comparison is not fair, and may lead to costly errors in judgment. It will place undue emphasis on the advantages of the new-type equipment, such as more speed, easier steering, easier shifting, hydraulic control, etc. If the contractor will investigate, he may discover that new models of the equipment he has been using incorporate the same improvements.

To summarize: fitting earthmoving equipment to the job implies use of equipment that will best serve the contractor's overall needs at the lowest possible cost. Speed, capacity, and the ability to move a lot of dirt a long distance are very fine when they contribute to this end. But when these contributions add to the cost per yard of earth moved, the machines which make them possible are obviously mis-fits.

How correctly equipment is fitted to the job will be revealed in the color of ink used by contractors when posting results of their operations!



LONG HAULS WITH SMOOTH HAUL ROADS give these speedy rubber-tired vehicles advantage over the crawler tractor. When such equipment can be kept busy on similar jobs, there is no question regarding its superiority.



TOPOGRAPHIC conditions and easement requirements were governing factors in choosing the route for Baltimore's water supply conduit

Seven-Mi. Tunnel Has Eight Line Changes

PAINSTAKING surveying coupled with a high degree of adaptability on the part of the contractor's organization have been called forth in the construction of a water tunnel that squirms its way under a busy part of Baltimore. With eight changes of line, two changes in grade and one change in diameter, this 7-mile excavation in hard rock is not what might be called a straightforward tunneling operation. But progress has been good since the start of the job in October, 1947, and contractor Sam R. Rosoff has every expectation of finishing within the allotted time of 900 days.

Work is being carried on from six headings. There is a heading at each of the terminal shafts, and two headings at each of two intermediate shafts. This divides the job into three sections as follows:

From Shaft to Shaft	Dia.	Length
Powder Mill to Druid	10 ft.	15,000 ft.
Druid to Stony Run	7 ft.	10,500 ft.
Stony Run to Montebello	7 ft.	10,500 ft.

Since all the shafts, together with a short section of tunnel at the foot of each, were excavated under a previous contract, the Rosoff organization has had to concern itself only with tunneling. The excavation has now been completed, and lining operations are being undertaken. Total cost of this work is represented by a bid price of $9,187,000.

Reasons for tunnel

The tunnel section now under construction forms part of a 17-mile conduit to conduct water from a new source of supply that will be established by Baltimore on the Patapsco River to the existing Montebello filtration works.

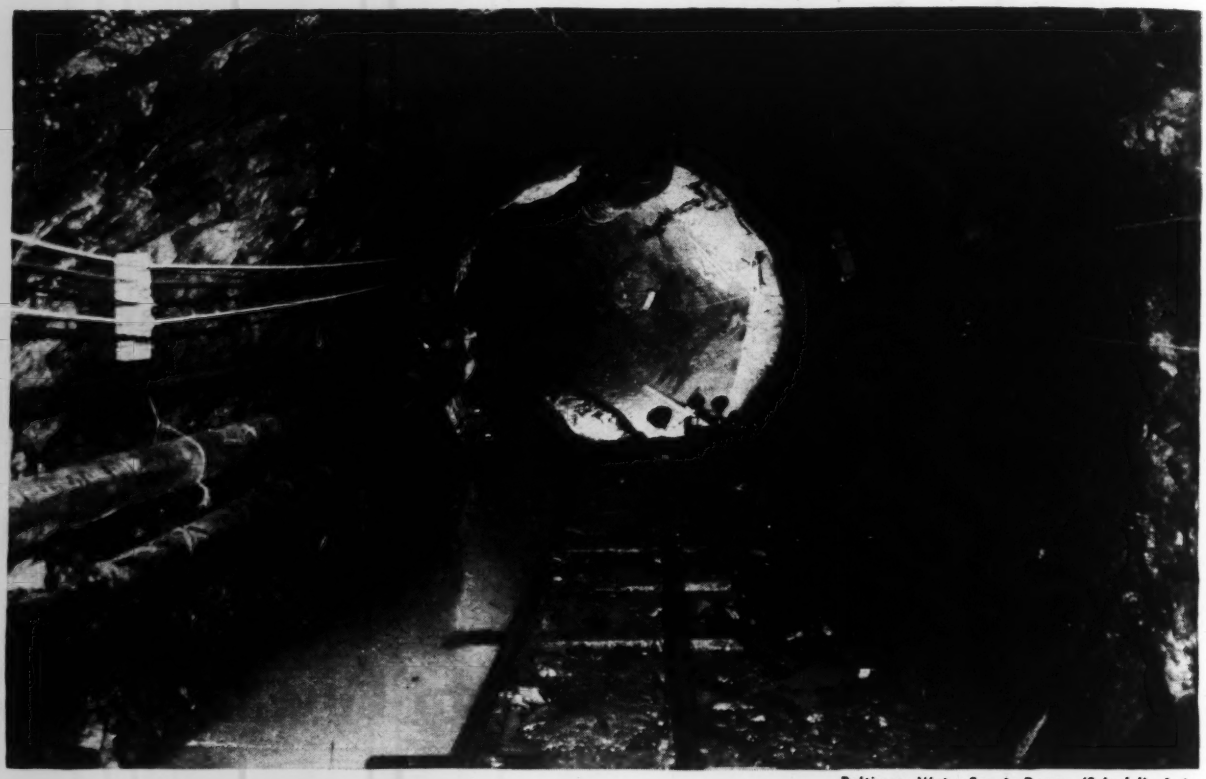
For 13 miles the conduit will be of 10 ft. diameter, and the remaining four miles of 7 ft. diameter. This makes provision for ultimate installation of a new filter plant at the termination of the 10 ft. section of the tunnel. At the completion of this filter plant, the 7 ft. section will be used as a connecting link between the two filter plants and also provide independent delivery of water directly into the distribution system.

Treated in this story are the four miles of 7 ft. diameter tunnel and a small portion of the 10 ft. diameter section. Contract for the remainder of the 10 ft. tunnel was awarded to Rosoff in July.

Since the 10 ft. section of the tunnel will convey raw water at all times, and has sufficient rock cover, it was decided by the engineers that conventional monolithic concrete lining would be satisfactory for this portion. The 7 ft. section, extending from the site of the future filtration plant to the Montebello filtration works, will ultimately be used for distribution of filtered water, and tightness of lining is of paramount importance from a sanitation standpoint. Also the hydraulic gradient is well above the ground line in a high-value residential section and in a community business district of the city, which makes the feature of water-tightness of considerable importance. A deficiency of rock cover at several points in this section is likewise a contributing factor calling for water tightness of the lining. As a consequence, it was decided to use a precast concrete cylinder pipe to be installed inside the tunnel in order to meet this condition.

Design for rock overburden

The design basis for effective rock overburden assumes that the height of the overburden necessary would be determined by the weight of a vertical prism of rock overlying the tunnel bore as excavated, with the inter-



Baltimore Water Supply Bureau (Schudel) photos

FIG. 2. GOOD PROGRESS (maximum 5,000 ft. per month) is maintained despite the limitations imposed by the relatively small bore and frequent changes in tunnel alignment. This is the 7-ft. section east of the Stony Run shaft.

nal pressure acting on a diameter equal to the internal diameter of the finished structure.

With the profile of the tunnel indicating a deficiency of effective overburden at the crossings of Jones Falls, Stony Run and in the vicinity of Loch Raven Boulevard, a lined pipe capable of withstanding the entire static pressure was adopted. This will have a wall thickness of 8 in. In other sections of the tunnel a lighter reinforced concrete pipe with a wall thickness of 4½ in. will be used.

After completion of the monolithic lining and the concrete backfill around the 7 ft. precast concrete pipe, the entire tunnel is to be grouted.

Accurate survey procedures

Alignment of the tunnel, with its eight changes in direction, reflected the desire of the engineers to locate the tunnel as much as possible under existing public streets and property. Wherever the tunnel passes under private property, it was necessary to acquire easement rights. In some cases payment for such rights was waived by the owners, and in other cases as much as $1.50 per foot had to be paid by the city.

With so many changes in line, surveying requirements have been given special attention:

The center line of the tunnel was precisely surveyed on the surface from one end to the other, this being done with absolute accuracy using a 10-sec. transit and first-order chaining.

At each shaft, center-line points were established on concrete monuments, one about 100 ft. from the shaft, and the other as far away as possible to obtain a good sight. Transfer of the center line from the surface to the bottom of the shaft was accomplished by the use of two 45-lb. plumb bobs suspended in a medium heavy oil with 12-gauge, covered blasting wire.

Normal procedure was to set up a transit over the monument closest to the shaft, sight on the monument farthest away from the shaft, and then clamp the transit on this line. Two reels on either side of the shaft, to which were attached the plumb bobs, were set directly on the center line of the tunnel. Lateral adjustments of the wire were accomplished by a slow-motion screw and the wires were kept on center through constant checking by the transitman on top.

At the tunnel level, another transit was set up about 100 ft. from the shaft, approximately on center line, and "ranged in", until the vertical cross-hair was precisely on the center of both bob wires. The process of "ranging in" was accomplished by sighting first on the bob wire farthest from the transit, then observing the near wire, and moving the transit head by means of a lateral adjuster one way or the other as required, until the vertical cross-hair "split" the center of both wires. With a backsight of only 12 ft., as is the case at the Powder Mill shaft, any error in line is multiplied approximately 8½ times in every 100 ft. Consequently, with a line being run for 1½ miles from this backsight the error could be 650 times as great at the end of this distance.

With the "ranging in" completed, the lines previously established could be checked or, if it were the first time

for precise work to be done : the tunnel, accurate points were set. In the interest of accuracy it was usual to perform the line-dropping operation at least three times at each shaft as the tunnel advanced, and sometimes more, or until the lines established by different checks were so close that the variance was negligible.

Center-line points were carried in holes drilled in the tunnel roof. A tapered wooden plug about 8 in. long was driven into the hole flush with the rock and a spad, similar to a nail with the head bent over, marked the exact center. The bent-over head formed a hook from which a plumb bob was hung for sights, or for setting up the transit.

It is interesting to record that when the 2-mi. section of the tunnel from Druid Hill to Stony Run was holed through on June 5, the headings were only $\frac{3}{4}$ in. off line.

Construction operations

Aside from the limitations imposed by the relatively small size of the tunnel and frequent changes in alignment, the physical conditions faced by the contractor are these:

Depth of the tunnel is variable, depending on surface topography, the maximum being 300 ft. and the minimum 60 ft. Throughout the length of the tunnel the rock is hard and reasonably sound, consisting of four general types—basic igneous rock; granite, gneiss and quartzite. As a consequence, it has been necessary to support only about 3 percent of the excavated portion.

For the most part, water infiltration has been of small importance, some 600 gpm. entering the Powder Mill shaft and about half this amount at each of the other shafts. However, the last 400 ft. between Druid east and Stony Run west presented some excavation difficulties due to the infiltration of a considerable quantity of water ranging intermittently from 30 to 150 gpm. Grouting was required before excavation could progress. This section also required support in the form of steel ribs of 4 in. H-beams placed on 3 ft. centers. The rock was predominantly decomposed quartz and mica schist and had no life.

As outlined by M. L. MacLean, chief engineer of Samuel R. Rosoff, Ltd., the plant and equipment for carrying out the work reflects this philosophy:

"Successful tunnel driving is dependent upon maintaining a reasonable cycle of operations consisting of drilling, blasting and mucking. The more frequent and monotonous this routine becomes, the more favorable is the result. Therefore, each piece of equipment, seemingly minor when judged independently, is of major importance. Furthermore, in small tunnels the restricted space eliminates the possibility of 'move out and replacement' without a very considerable interruption in the production cycle."

Continued Mr. MacLean: "The problem of choosing equipment today is magnified by the inability at all times to obtain delivery of items that have proven their reliability by past performance and which sometimes requires compromises with available alternates. In this respect, we acknowledge and appreciate the help and cooperation received from local distributors."

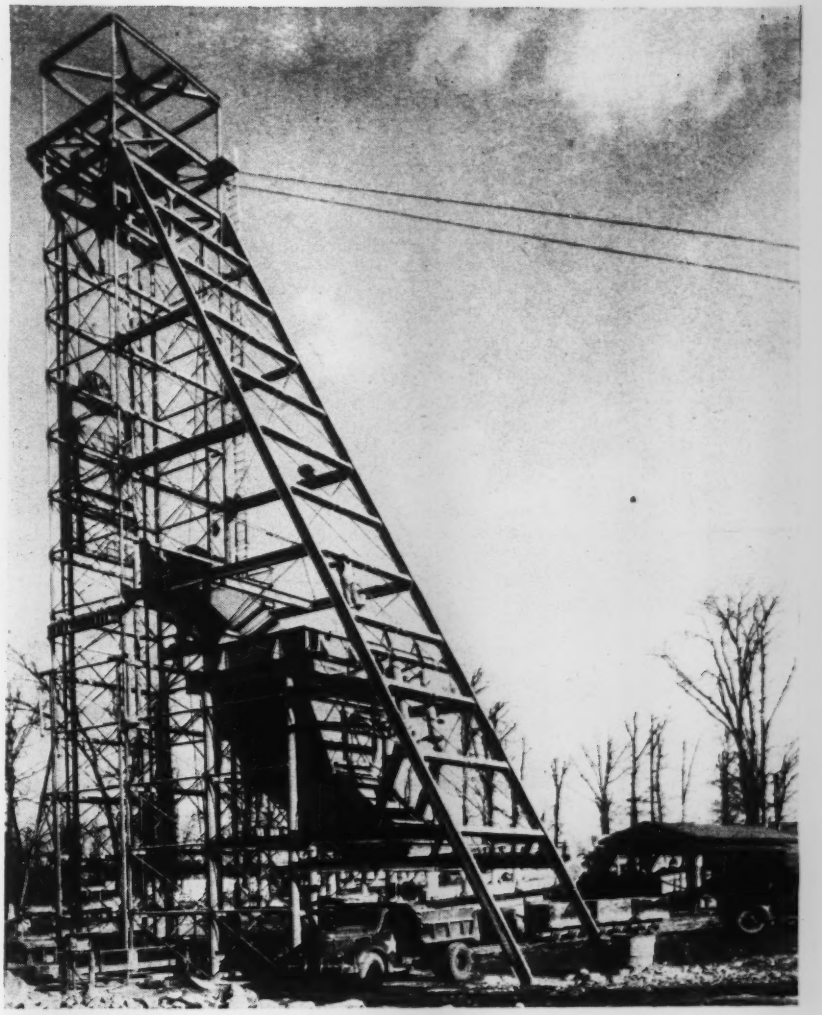


FIG. 3. HEADFRAMES of tubular steel construction and extending about 80 ft. above ground level combined with a structural steel rock-bin assembly facilitate removal of excavated material at each shaft.

Plant and equipment

Equipment provided at each of the four shafts is similar, with the exception that at the two terminal points compressed air is produced by Diesel-driven units rather than electrically driven units as is the case at the two intermediate points. Diesel units were selected because: (1) Delivery could not be made on electrical equipment to meet production schedules; and (2) cost of extension of

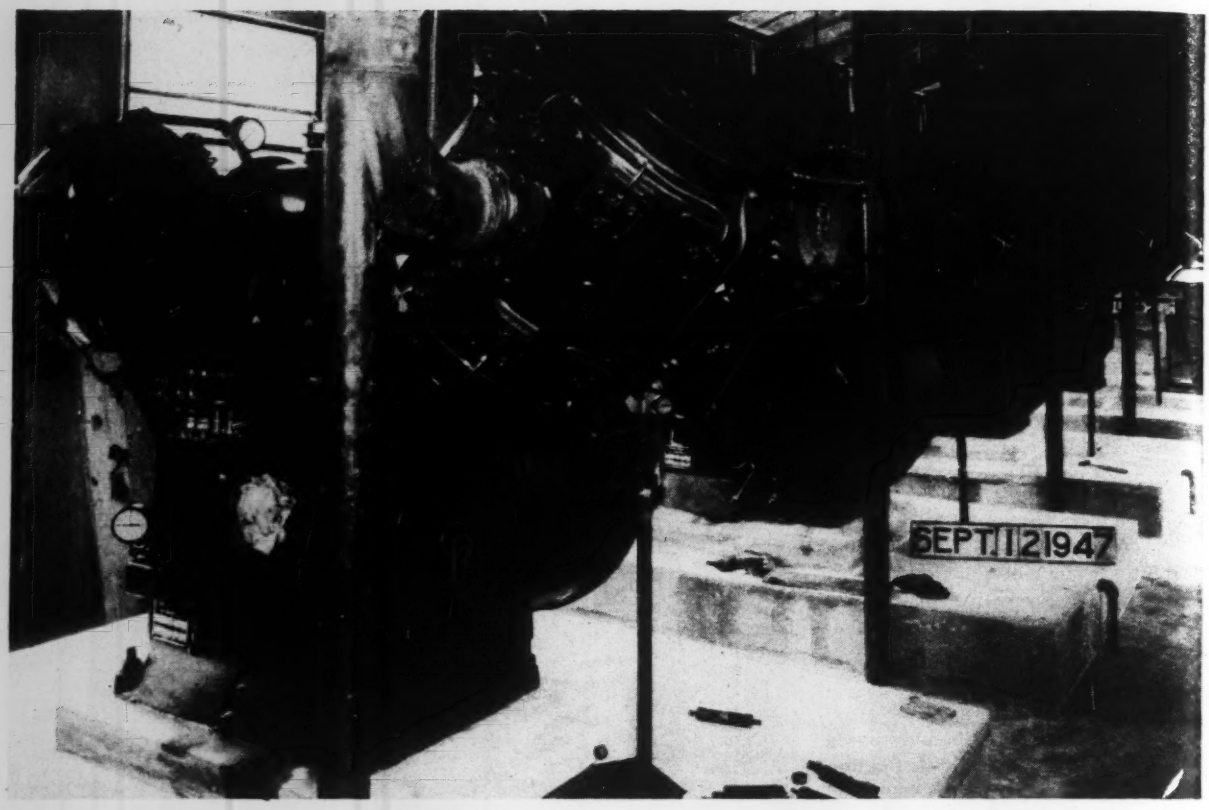


FIG. 4. BATTERY OF FOUR AIR-COMPRESSORS with a total capacity of 2,600 cfm. This type of installation, electrically driven, is used at the intermediate shafts. At the terminal shafts, diesel-driven units are employed.

power to these points was considered excessive.

A typical layout at each shaft includes:

(1) A tubular steel head frame founded at tunnel grade and extending to a height of about 80 ft. above ground level. Each headframe is equipped with a platform cage operated with counterbalance by a single drum mine-type hoist. Cages are operated on a two-part line with a load speed of 250 fpm. and are equipped with mechanical safety devices designed to hold a full load in the event of cable failure.

Adjacent to each headframe at ground level, and at an appropriate distance above the ground, a structural steel rock-bin is provided. Excavated materials are transported in cars onto the cage, hoisted to the top level of the storage hopper and dumped without removal from the cage itself. Rock is then loaded into trucks for ultimate disposal.

(2) Compressed air at the intermediate shaft is supplied by electrically driven compressors having a total capacity of 2,600 cfm. in four units, and at the terminal shaft by Diesel-driven units having a total capacity of 1,500 cfm. in three units.

(3) Ventilation for the tunnel is provided through electrically driven fans having a capacity of 5,000 cfm. for each heading, the air being delivered through an 18 in. steel pipe. All blowers are equipped with gate valves so that they can be used either for delivery of fresh air or for exhausting air from the tunnel.

(4) Haulage power is provided by 7-ton storage battery locomotives. An extra battery is provided for each locomotive so that a reserve unit may be on charge at all times. Locomotives are transported to the surface for transfer of batteries, which are recharged at the surface level.

(5) Drilling of rock is performed with five 3½ in. pneumatic drifters mounted on a drill carriage unit for each heading. The drill carriage was fabricated on the site. Forged drill-steel, fashioned at a central shop located at the Druid shaft, is used throughout. Drill steel is provided in multiples of 2 ft. with ⅛ in. gage changes. Starter steel is 3 ft. in length and each successive drill is 2 ft. longer. Usually about 2 ft. of rock can be drilled before the drill needs sharpening. In a few places the rock was exceedingly hard and required three sets of drills for each 2 ft. of change.

(6) Removal of blasted rock is accomplished with steel body, side dump cars of 2¾ cu. yd. capacity. The loader or mucking machine operates on a 36 in. gage track and travels on a 24 in. gage track.

(7) Haulage within the tunnel and at the surface level adjacent to the shaft is maintained on a 24 in. gage track using 60 lb. industrial rail with standard switch points and frogs. Track is laid on 6 x 6 ties, on 3 ft. centers. To accommodate the mucking machine which operates on the 36 in. gage track, it was necessary to carry double track from the face of each heading to a point about 100 ft. away.

(8) At the foot of each shaft, a sump has been excavated below the tunnel grade. Electric-driven pumps are installed at this point with sufficient capacity to care for water infil-

tration. Water entering the tunnel at points some distance from the shaft is collected locally by air pumps and discharged into a 6 in. pump line which is maintained along the side of the tunnel and which leads to the main shaft pump.

Drilling pattern

In drilling the face, a typical round consists of 32 holes drilled to a depth of 9 ft. The pattern for drilling is usually the same for all headings and varies slightly, depending on the rock structure. Drilling time, excluding time spent in setting up equipment, varies from a little over one hour to three hours in extreme cases.

Anywhere from 150 to 225 lb. of 40 or 60 percent dynamite (depending on the character of the rock) is loaded in the holes. The blast is detonated electrically in a series of eight delays at one-fifth of a second interval. Powder use has averaged about 7 lb. per cu. yd. of rock removed.

The job is operated on a three-shift basis, around the clock, six days per week. Total lineal feet of tunnel excavated since the beginning of excavation in October 1947 to June 1, 1948 was 25,000 ft. Maximum monthly progress has been slightly less than 5,000 ft.

Acknowledgment

The Baltimore water tunnel is being constructed under the general direction of Leon Small, water engineer, assisted by J. S. Strohmeyer, deputy water engineer. Bernard L. Werner, principal associate engineer of the Bureau of Water Supply, is in charge of field operations.

For the Samuel R. Rosoff, Ltd., contractors on the work, Samuel R. Rosoff is president and Stanley Rosoff is secretary. M. L. MacLean is chief engineer, Philip S. Miller is assistant chief engineer, and A. T. Araneo is chief field engineer.

John Holden is project superintendent, George Underwood is tunnel superintendent, and Fred Johnson is superintendent of equipment.

Notes on Legal Decisions

Summaries of decisions relating to construction, prepared by I. Vernon Werbin, counselor at law and engineer, New York

Overhead in Cost-Plus Contracts

Ordinarily a contract for doing work on the basis of time and material plus a percentage for profits will not include allowance for overhead unless this allowance is clearly provided in the contract. The term "time and material" and like expressions refer solely to the payment on the particular work under the contract and the actual cost of materials furnished. The words will not be extended beyond their actual meaning. One thus contracting engages to furnish and keep in condition the tools and necessary equipment to do the work[1].

To allow overhead as an item of cost in such contracts would open the doors to a flood of obligations not intended by the words used. Each outlay for labor and materials becomes a part of the work. To this is added a certain percentage to take care of the proportionate share of the contractor's overhead and general expenses and profit[2]. Supervision is overhead as distinguished from direct labor, and is not allowable as an item of cost in a cost-plus contract[3].

(1) Advance Auto Body Works, Inv. v. Asbury Trans. Co., Inc., 52 p. 2nd, 958.
(2) Vinson & Pringle v. Lanteen Medical Laboratories, 159 P. 2nd, 612.
(3) Howard P. Foley Co. v. United States, 63 F. Supp. 209, reversed in 91 L. ed. 135 on other grounds.

Liability for Defective Plans

In preparing plans and specifications, the architect must possess and exercise ordinary care and skill. If he does this, he is not liable for faults in construction resulting from defective plans, as his undertaking does not guarantee a perfect plan or satisfactory result. It is considered enough that the architect himself is not the cause of any failure, and there is no implied promise that miscalculations may not occur. Where, however, the architect does not possess and exercise such care and skill he will not only be liable in damages for defects in his plans, but he also cannot recover compensation for them.

(1) White v. Pallay, 247 P. 316.

Entire and Divisible Contracts

A contract is entire when the parties intend that the promises by one party are conditioned upon entire performance of his part of the contract by the other party. A contract is said to be severable when the part to be performed by one party consists of several distinct and separate items, and the price to be paid by the other is apportioned to each item or is left to be implied by law[1].

Where a contract is entire, the contractor must do all the work required before he is entitled to payment. If he fails to complete the work, he is responsible for the damage sustained[2].

Generally, one who has breached an entire contract to be performed for an entire price, cannot recover either on the contract or upon a quantum meruit. Where the contract consists of several distinct items (the consideration to be apportioned to each item as a separate unit rather than as part of the whole), the contract is severable or divisible. Whether a contract is entire or divisible depends upon the intention of the parties as disclosed by the language of the contract—the manner in which it is to be performed, the method of payment, and the circumstances attending its execution and operation[3].

(1) Ming, et al. v. Corbin, 142 N.Y. 334.
(2) Integrity Flooring, Inc. v. Zandon Corporation, Inc., 32 A 2d, 507.
(3) Carrig v. Gilbert-Varker Corp., 51 N.E. 2d, 59.

No Recovery for Illegal Plans

An architect cannot recover for services rendered in preparing plans and specifications for a building when the plans do not conform with the local zoning ordinance. An architect is charged with knowledge of the zoning restrictions of a designated locality and plans for the proposed structure must comply[1].

(1) Bott v. Moser, 7 S.E. 2d, 217.

INCREASING THE POWER SUPPLY in California by 99,000-kva., the Electra power plant—a Pacific Gas & Electric Co. project—is an example of new trends in power plant design.

BUILDING THE STEEL PENSTOCK required a special inclined cable tramway, which will be left in place.

High Head Penstock Shop Welded and Field Riveted

A HIGHLIGHT of this year's hydroelectric construction program in the Far West is the Mokelumne project, a Pacific Gas and Electric Co. job.

New solutions to old engineering problems are involved in parts of the Electra power plant, major unit of this development. For example, the Electra penstock is designed to take full advantage of shop-welding procedures; a special shop procedure insures a tight field connection using only rivets; automatic controlling devices are used for impulse turbine nozzles and a spreading weir controls erosion in the plant afterbay.

The Electra plant is located on the North Fork of the Mokelumne River 130 miles northwest of San Francisco, and can serve the middle portion of California's Central Valley as well as the San Francisco Bay area.

Water for this plant will be taken either from the discharge of the new 16,000-kva. West Point power plant or directly from the river by means of a diversion dam located at West Point. It will travel through a 43,000-ft. tunnel having an 12 x 15.5-ft. horseshoe section, which discharges into a 1,000-acre-ft. capacity regulating reservoir. Thence the water goes through a 3,000-ft. tunnel that discharges into the steel penstock.

Except for the regulating reservoir, all facilities serving the new plant are newly constructed. The reservoir was formed by Tabeaud Dam, a 123-ft. high earth-fill structure built in 1901 (*Engineering News* July 10, 1902, p. 26). This dam, one of the first constructed by spreading fill in thin layers, ranked among the highest earth-fill dams when built. No maintenance work has been required on the 47-year-old structure except for removal of trees growing on its slopes. There has been no leakage through the dam or sloughing of material. Power company engineers believe that it ranks among the best earth-fill dams in the company system. Silting has not been great enough to diminish the useful reservoir capacity significantly.

Head is 1,268 ft.

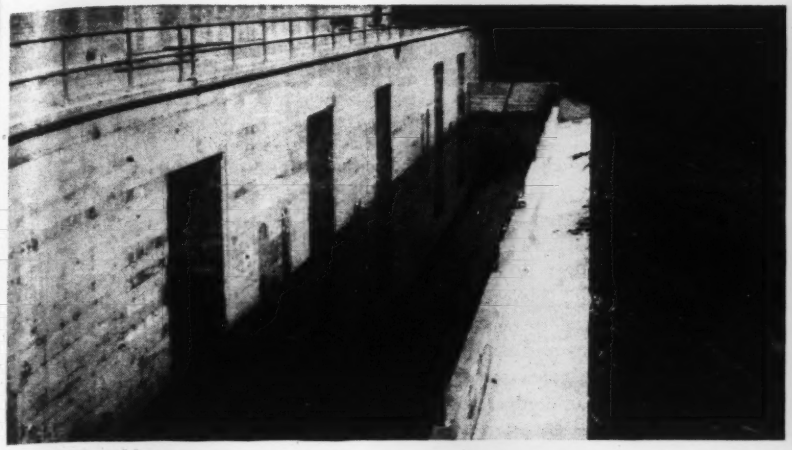
The maximum static water surface on the new penstock is at El. 1960, and the invert of the discharge portion of the penstock is at El. 691.7, thus giving a maximum head on the penstock of 1,268.3 ft. Actual invert elevation of the upstream end of the penstock is 1892. Maximum slope is 35 deg. and the length is some 3,400 ft. Thickness varies from 7/16 in. at the top to $1\frac{3}{4}$ in. at the bottom. Diameter varies from 120 in. at the top to 90 in. at the bottom.

The steel penstock is designed to take maximum advantage of shop welding with a resulting saving of material. Each 30-ft. section is made of three 10-ft. wide plates joined together by two circumferential, machine-made welds. The three longitudinal welds required to form the three plates into a cylinder are staggered so alternate welds are 45 deg. from the top of the penstock.

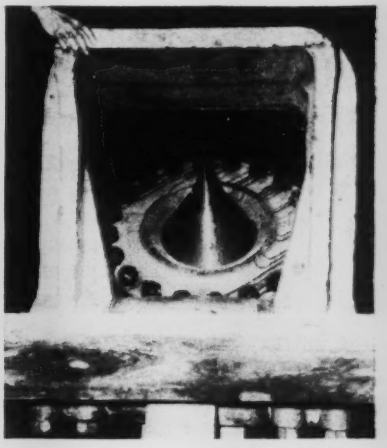
An additional narrower plate was welded on one end of each section to form a bell. Rivet holes were drilled in the bell as well as in the end of the section to go next above so that a simple riveted joint could be made in the field. By welding the bell or collar to the pipe in the shop, butt-strap material was conserved and field riveting reduced by 50 percent.

Tolerance allowed in the fit of adjoining sections was $\frac{1}{32}$ in. for the full diameter, requiring a close shop fit. Rather than machining the sections to size—an expensive shop procedure—this fit was made by a heating to expand the end needing enlarging and a quick cold-water quench that resulted in a permanent set in the expanded position. This procedure was repeated as needed until the required fit was obtained.

Special sections for closing and for bends were made in a similar manner.



THE LOW WEIR WALL spreads the flow coming from any one of the generators evenly over the slope to the river to prevent erosion in the weak formation on the river bank.



ONE OF THE NEEDLES seen from underneath. The deflector is seen in position to divert the full flow.

All welds were X-rayed for flaws, and the sections were stress-relieved.

The pipe sections were trucked to the job and unloaded by a derrick. To prevent distortion, thin-shelled sections were shipped with a spider in each end. They were trammed to position, unloaded by means of a winch at the upper end, snaked to position and seated. To avoid the possibility of developing welding stresses that could not be relieved, all field connections were riveted.

Improved hydraulic machinery

The power plant has three 33,000-kva. generators each driven by double overhung impulse waterwheels, which have special regulating equipment that permits them to operate on a water-saving principle and make maximum use of available water.

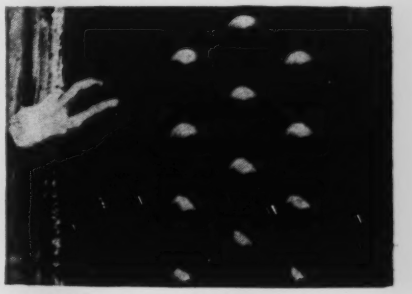
Part of this advantage obtains from the manner in which the jet deflectors and the needles are coordinated. One actuator operates the deflectors for both waterwheels on each generator. However, each deflector is also tied in with the jet controlling device for each needle. As a special precaution, springs will automatically shut the waterwheel down in event of failure.

In case of a change in load on the generator, with its resultant change in the turbine speed, the deflectors move either into or away from the jet, depending upon the increase or decrease in speed. This motion of the deflector is transmitted through mechanical linkages to the jet controller where valves using pressure oil from the oil pressure system are operated. A movement of the needle is thus initiated. Such movement follows the deflector at a slower rate and controls the flow of the jet until equilibrium is again established with the deflector just clear of the jet. The deflector never actually enters the jet on minor load changes since the needle, following the deflector movement, controls the jet flow.

Although the load is thus quickly adjusted, slow movement of the needle prevents water hammer and consequent damage to the penstock or other equipment. Besides this, such a system conserves available water and also prevents bucket wear from continuous distortion of the jet by the deflector.

Since the discharge of the power plant is separated from the river during periods of low flow by some 20 ft. of undisturbed soft seamy schist, a low discharge weir was installed to minimize erosion. This concrete weir is about 2 ft. high and distributes discharge from any one or all of the six waterwheels so that there is even flow across the soft material. This is expected to keep erosion to a minimum with no resultant damage to the plant foundations.

This plant is a project of the Pacific Gas and Electric Co., for which I. C. Steele is vice-president and chief engineer and Walter Dreyer is chief of the civil engineering division. The civil engineering design was under the immediate supervision of T. J. Corwin, assisted by J. B. Cooke. Directing construction for the company was H. W. Haberkorn, engineer of hydroelectric construction. Penstock contractor is the Western & Steel Co. of Calif. Morrison-Knudson Co., Inc. built the power plant building and the machinery was installed by the Bechtel Corp. Electrical equipment was supplied by Allis-Chalmers Mfg. Co. Hydraulic machinery was designed and supplied by The Pelton Water Wheel Co., San Francisco.



COLLARS welded on one end of the 30-ft. penstock sections formed a bell that fits over the adjacent section. The penstock was shop-welded and field-riveted.

Army Tests New-Type Slide Gate

Full-scale tests by the Army Engineers of slide gates under high heads at Norfork Dam indicate that a gate leaf with a 45-deg. upstream bevel at the lower edge eliminates most of the difficulties encountered in operating slide gates at partial openings. Model tests at the Waterways Experiment Station preceded selection of the design for the full-scale gate.

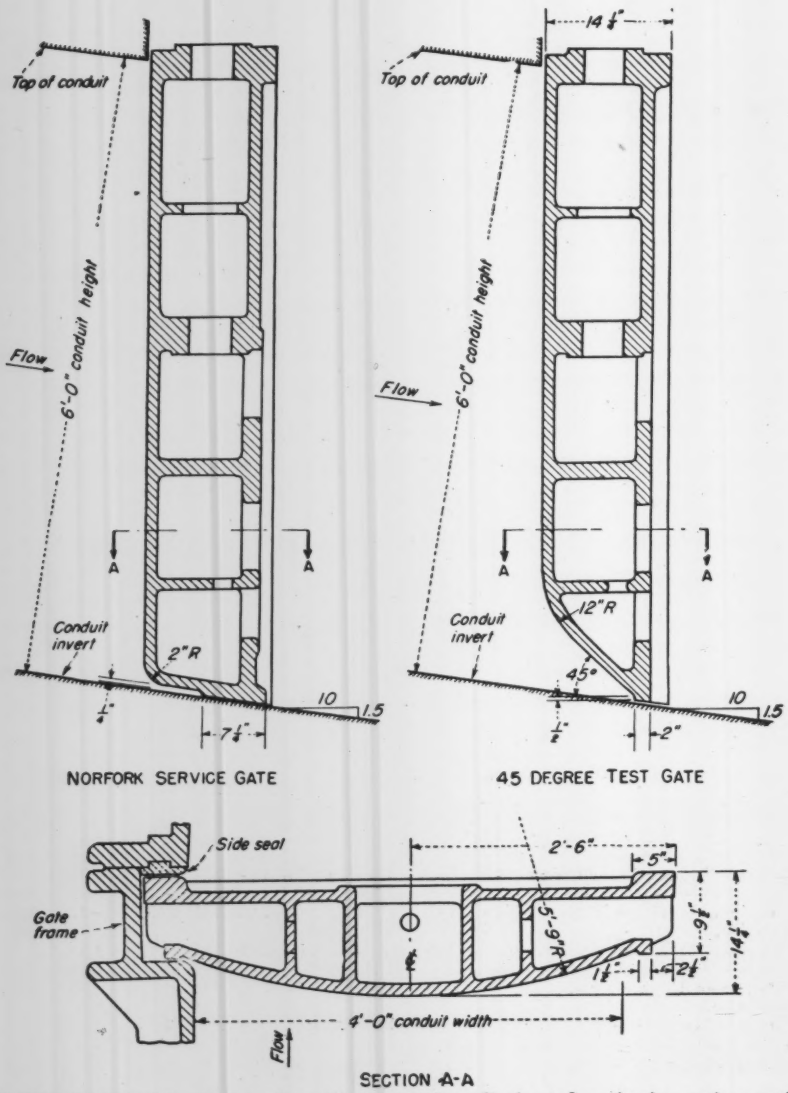
In operation under 160-ft. head at Norfork, a 4 x 6-ft. slide gate with a 45-deg. bottom edge gave promising results at part-gate openings. The improved design eliminated all telltale sounds of cavitation and greatly reduced gate vibration in the partially-open positions. Elaborate apparatus was employed to pick up instantaneous pressures and vibrations.

Historically, slide gates are among the oldest devices for controlling the discharge of water through dams. As long as the flow and the head is small, hand-operated slide gates are efficient.

But, as the height of dams increased and the quantity of water to be discharged outgrew the capacity of ordinary control equipment, other forms of valves and gates had to be developed. Some operated satisfactorily; others developed basic weaknesses that soon eliminated them from further consideration for the control of water under high head and partial gate opening.

As storage capacity and height of dams steadily increased, the popular opinion developed that slide gates could not be used at partial openings, especially for high heads (over 75 ft.) and for long-continued discharge, because of chatter and vibration.

After a thorough study of the assumed cause and the effect of these objectionable performances, the Corps of Engineers arrived at this hypothesis: If the bottom of the slide gate leaf were so shaped as to eliminate negative pressure on the lower part and to guarantee non-fluctuating positive pressure at all points on this edge—regardless of the opening—there would be no objectionable effects resulting from long-continued operation at part-gate opening.



SLIDE GATE with 45-deg. sloped bottom edge eliminated cavitation noises and effected a great reduction in vibration when tested at partial openings under 160-ft. head in an outlet conduit at Norfork Dam.

Slide gate experiments

Prototype testing of such a gate installation has just been completed at Norfork Dam in northern Arkansas, where a head of 160 ft. and 4-ft.-wide by 6-ft.-high slide gates in conduits through the concrete dam were available. The accompanying drawing shows two types of gate leaf shapes investigated in both model and prototype tests.

Prior to the experiments at Norfork, the Waterways Experiment Station tested, in 1 to 6 scale models, five different slide gate leaf shapes. Based on those model tests, the Norfork type and the 45-deg. type of gate leaf were selected for prototype testing.

The model studies were limited mainly to obtaining average piezometric pressures on the upstream face and bottom of each gate leaf and to observations of tests in a cavitation

tank. Data obtained in the prototype tests include average and instantaneous pressures on the gates and in the downstream conduits, gate vibration and strain measurements, and air demand.

Tests at Norfork Dam

Apparatus for measuring and recording prototype data include SR-4 strain gages, six-channel amplifiers, Westinghouse type AO recording oscillographs, vacuum tube voltmeter, 24- and 100-in. mercury U-tubes, high pressure dial gages, and a Velnor air-velocity meter.

Results showed that operation of the 45-deg.-type gate is superior to that of the Norfork-type gate. High negative pressures on the gate bottom, considerable gate vibration, and crackling sounds characteristic of cavitation were noted for most gate openings of the Norfork gate. By contrast, high positive pressures occurred over the sloping bottom of the 45-deg. gate, resulting in elimination of the crackling cavitation sounds and in a marked reduction in gate vibration. The tests indicate that the 45-deg. gate would operate satisfactorily at part-gate openings under high heads for long periods of time, provided the gate slots are properly designed.

Incidental to the slide gate tests, the Waterways Experiment Station is conducting a series of gate-slot tests for the purpose of developing cavitation-free slots.

After the test data have been thoroughly analyzed, a separate report on each of the several phases of the model and prototype tests will be published by the Waterways Experiment Station.

The Corps of Engineers is currently engaged in a comprehensive program of developing and testing reservoir outlet gates for high-head operation. Slide and tainter gates have been selected for detailed investigation because of their economy, simplicity, superior hydraulic performance, and structural rather than mechanical character.

The gate testing program is under the general direction of the Office of the Chief of Engineers. All model tests related to the program are being conducted by the Waterways Experiment Station. Prototype tests are made by the Little Rock Engineer District.

Many Sharp Rises Reported In Railroad Construction Costs

Unusual increases in the cost of several types of railway construction work are reported in the current issue of "Railroad Construction indices," which is compiled by the engineering section of the Bureau of Valuation of the Interstate Commerce Commission. These indices are based on 1910-1914 costs as 100 and were developed from analysis of major construction contracts for such items as grading, tunnel excavation, bridge construction, hauling and placing ballast, tracklaying and surfacing. Indices for items such as rail and ties are based on reports by the railroad companies to the Interstate Commerce Commission in connection with the commission's valuation work.

Major increases in 1947 figures over those for 1946 occurred in the cost of elevated railway structures and in bridge construction. As will be seen in the accompanying table, all the major items except grading, ties and ballast rose thirty or more points in one year.

In relation to prewar costs, the index number of most of the items rose more than 100 points, and the increase in bridge costs was nearly 200 points. The engineering index, being a percent of the total road account, reflects the general rise.

The relatively small increase in grading costs is noteworthy because it is to be assumed that the 1910-1914 costs were low in relation to other types of railroad work as the railroad engineering departments pioneered in the use of large earth-moving equipment and by that time were reporting notably low costs per cubic yard through the use of large steam shovels and trains of side-dump cars. Since then the advent of motorized carrying scrapers and bulldozers has served to keep the grading item in railway costs from rising as fast as most of the other cost items.

MAJOR ITEMS IN THE RAILROAD CONSTRUCTION COST INDICES OF THE INTERSTATE COMMERCE COMMISSION

Road Accounts	1915	1917	1923	1933	1939	1945	1946	1947	Increase 46–47	Increase 39–47
Engineering	101	131	171	127	137	197	216	245	+29	+108
Grading	100	130	160	98	90	144	148	154	+6	+64
Tunnels and Subways	103	128	179	111	140	236	260	304	+44	+164
Bridges and Culverts	105	146	176	122	149	240	272	327	+55	+178
Elevated Structures	102	169	173	122	149	249	281	346	+62	+194
Ties	100	112	177	139	158	241	252	270	+18	+112
Rails	101	121	145	131	136	152	165	210	+45	+74
Ballast	103	114	175	146	143	181	194	207	+13	+64
Track Laying and Surfacing	100	130	188	157	165	273	298	336	+38	+171
Fences, Snowsheds and Signs	100	138	183	135	141	189	206	242	+36	+101
Stations and Office Bldgs	101	135	194	145	166	244	291	333	+42	+167
Roadway Buildings	100	136	196	145	162	258	307	341	+34	+179
Shops and Enginehouses	102	141	193	142	165	248	294	336	+42	+171
Storage Warehouses	100	135	198	142	166	253	300	340	+40	+174
Wharves and Docks	100	133	175	141	153	255	291	328	+37	+175

The complete table covering 31 items can be obtained from the Engineering Section Bureau of Valuation, Interstate Commerce Commission, Washington, 25, D. C.

AN INTIMATE VIEW of the origin, operation and membership of a . . . . .

Reni photo for ENR

Clearing-House for Sanitary Engineering

How an advisory committee of the National Research Council is coordinating the resources of an entire professional group and why its recommendations are having a wide influence on technical practice.

Edward J. Cleary
Executive Editor, Engineering News-Record

FEW SANITARY ENGINEERS know about the Committee on Sanitary Engineering and Environment of the National Research Council. But the deliberations of this group, whose members would appear to possess a "passion for anonymity," touch upon the destiny of virtually every sanitary engineer and are being reflected in his technical practice as well.

Seven years ago, when the committee came into being at the request of the Surgeon-General of the Army, we were at war. Not the least of our shortages then was a lack of sanitary engineers for both military and civilian services. It was the initial task of the committee to recommend means for procurement and allocation of this specialized personnel.

Thus it was that the records of some 6,000 sanitary engineers were compiled, their status was classified as "critical" by the War Manpower Commission, and each man was screened individually to determine where his talents might be applied to best advantage.

The committee itself did not execute the program. But its decision that such a program should be undertaken was enough to assemble and coordinate for the first time the manpower resources of a somewhat amorphous professional group.

Since that day in August, 1942, when it was first convened "to render advice and assistance" to the Army, Navy and U. S. Public Health Service, the Committee on Sanitary Engineering and Environment has made many other recommendations. All of them have had, or promise to have, a profound influence on the practice and the position of sanitary engineers throughout the nation.

Accent on radioactive wastes

One of its most recent endeavors, for example, was to focus quiet attention—in high places where it would do the most good—on the public-health hazards of radioactive wastes. Among other things, this led to the

SHOWN in the picture *(left)* are: Seated (l. to r.) Ray E. Lawrence; William A. Hardenbergh; Abel Wolman, chairman; W. George Parks; and Harold A. Whittaker.

Standing (l. to r.) are: Gordon M. Fair; C. P. Yaglou; Theodore F. Hatch; Walter D. Tiedeman; Paul F. Russell.

appointment of a sanitary engineer on the staff of the Atomic Energy Commission to aid in formulating what promises to be entirely new concepts in pollution detection and control.

Background of the committee

To understand how the committee operates and under what auspices, one must turn back almost a century. It was in 1863 that the Congress granted a charter for the formation of a National Academy of Sciences, which provided that:

> "The Academy shall, whenever called upon by any department of the government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments and reports to be paid from appropriations which may be made for the purpose, but the Academy shall receive no compensation whatever for any services to the government of the United States."

Thus, the academy became an official adviser to the federal government on a wide variety of technical matters. With the advent of World War I in 1916, the academy established as its agent the National Research Council to assist the government in organizing the scientific resources of the country.

The work of the NRC proved to be so effective in promoting cooperation among military and civilian agencies on scientific problems that President Woodrow Wilson issued an executive order in 1918 establishing the council on a permanent basis. It was ready and available therefore, to exercise an important function in World War II.

The council is composed of eight major divisions, under the direction of which there are numerous technical committees and subcommittees. Financial support for administrative functions is provided from a Carnegie Corporation of New York endowment and other funds. Scientific projects sponsored by the council are supported by special gifts and appropriations from various sources. Activities are centered in Washington, in a building designed and built for the joint use of the academy and the council.

Describing itself as a "cooperative organization of the scientific men of America," the NRC outlines its functions as follows:

> "The Council is not an institution for the maintenance of scientific laboratories. It is rather an organization which, while clearly recognizing the indispensable value of individual investigation, hopes particularly to integrate the work of individual scientists and to assist in coordinating in some measure, scientific attack in America upon large problems in the fields of scientific inquiry."

Where sanitary engineering fits

Although the council organization includes a division of engineering and industrial research, the sanitary engineers found no encouragement from this division to come under its purview—a situation apparently akin to that of a mother failing to recognize her own child. As a consequence the committee was set up to function as part of the division of medical science.

Chairman of the committee is Abel Wolman, professor of sanitary engineering, The Johns Hopkins University. Other members are: Gordon M. Fair, dean of the graduate school of engineering, Harvard University; William A. Hardenbergh, president and editor, *Public Works* magazine; Theodore F. Hatch, research director, industrial hygiene division, Mellon Institute; Ray E. Lawrence, consulting engineer, Kansas City, Mo.

Also: Kenneth F. Maxcy, professor of epidemiology, The Johns Hopkins University; W. George Parks, professor of chemistry, Rhode Island State College, Paul F. Russell, The Rockefeller Institute; Walter D. Tiedeman, chief sanitarian, New York State Department of Health; Harold A. Whittaker, professor of public health engineering, University of Minnesota; and C. P. Yaglou, professor of industrial hygiene, Harvard University.

Originally the group was known as the Committee on Sanitary Engineering. Addition of the word "environment" to its title was a recent change to define more properly the scope of its work. For example, the term sanitary engineering by itself failed to convey the committee's interest in matters pertaining to shelter, insect and rodent control. Nor did it necessarily connote a valid concern with food handling, although both shelter and food sanitation are intimately associated with environmental health problems.

Work is subdivided

Occupied as it is with a great variety of problems, the committee places responsibility for specific projects with subcommittees. The latter generally includes one or more members of the main committee, supplemented with specialists in the work under investigation.

Thus it cannot be charged that the committee considers itself omnipotent in reaching decisions. In fact, on some matters, the subcommittee personnel may consist entirely of men outside of the committee who have been chosen as representatives of the best available talent for the work in hand. Such was the case in drafting the plan for establishment of a national catastrophe organization (*ENR* April 1, vol. p. 473).

Subcommittee reports, of course, are subject to acceptance by the committee, which may or may not call for modification of conclusions. This procedure makes it possible for the committee to assume complete responsibility for final decisions that not only represent its best judgment but also are responsive to the viewpoints of highly qualified outside specialists as well.

Typical Undertakings

Projects under consideration by the committee vary according to time and circumstances. Early in the war its principal concern was procurement and assignment of sanitary engineers. Then came the problem of water supply cross-connections and the steps that should be taken to minimize this possible hazard to distribution systems, particularly in the advent of sabotage.

Equally important in the field of water supply was a study pointing to the desirability of maintaining a chlorine residual in the distribution

system. Recommendations of the committee in this regard were adopted at all Army installations and have since influenced practice in many municipal operations.

A notable postwar undertaking was the compilation of all information relating to sewage treatment at military installations. Not only is this invaluable as a document of record but also as a critical analysis of design and operating procedures. Had not the committee addressed itself to the collection of this information, it would have been irrevocably lost, as was the case with data on army-camp sewage-disposal experiences during World War I. Adding to the value of the committee's report (published in two parts in Sewage Works *Journal*, September 1946 and January 1948) are recommendations as to design, operation and management of facilities for future military installations.

Among matters currently under study is one to challenge both the scientific spirit and the physical hardihood of the committee. Charged with making recommendations for environmental sanitation practice under Arctic conditions, the committee has found little in the way of precedent or experience for guidance.

Therefore, its members have gone directly into the field to gather data and make observations. What this entails can be appreciated in a report from three of its members who left the balmy climate of the United States last April for the Arctic countryside where temperatures ranged from a high of 37 degrees to a low of minus 57 degrees. On the basis of their findings and those of other members to follow, the committee will formulate procedures for water supplies, sewage and refuse disposal, food storage and handling, mosquito control and housing facilities in Arctic regions.

Not all can be told

In discharging its function, the committee must logically devote its efforts to problems associated with the national defense. As a consequence, many of its deliberations and actions come under security regulations.

Operating in this twilight zone where the glare of publicity is screened by the fog of secrecy, the complete story of this NRC committee cannot be revealed. From what has been told, however, it should be clear that this is a potent group. Not only does it speak with authority for the entire profession of sanitary engineering in high places of the nation, but in so doing the echoes of its powerful voice eventually reach down to every cranny of practice.

Because it imposes a great responsibility as well as confers a rare privilege, membership on the committee may indeed be considered a coveted honor. Those who are serving on this committee, by appointment of the president of the National Academy of Science, will be recognized by their colleagues as deserving of this honor.

Individually, they have made rich contributions to the advancement of sanitary engineering. Working together as a group, their endeavors are making it possible for the profession to render a unique service to the nation.

Increased Fares on City Transits Provide Needed Operating Revenue

Increased fares are solving financial problems for municipally-owned transit systems, according to the Municipal Finance Officers Association.

Some or all of the transportation facilities of 29 cities over 10,000 population in the United States are municipally owned.

Cleveland, Ohio, since increasing its fare 20 percent in June, has taken in enough money to pay all operating costs, meet all payments on debts, put aside money for depreciation and still have a surplus. With a 12-cent fare, Cleveland's deficit last year was $2 million.

Higher fares permit better wages

Estimates place New York's revenue for city-owned transit lines 50 percent higher since the fare increase in July. Subway fares were upped to 10 cents and bus fares went from five to seven cents. The increased revenue will meet a $52 million operating deficit as well as provide wage increases for 33,000 rapid-transit operating employees.

Last April when its transit lines showed a $1 million loss for the preceding six months, Detroit increased fares from 10 to 13 cents. The first three months of operation under the new rate show a net income of $797,639.

Chicago, which only a year ago took over the privately-owned street railways and the elevated subway system, showed an earning of $901,826 in July—the first month under the present transit rate of 15 cents for rapid transit and 13 cents for busses and streetcars. In the first six months of municipal operation the transit lines lost $2.5 million.

Santa Monica, Cal., which operates a municipal bus line, has doubled its fare since V-J day. Now charging 10 cents per ride or three tokens for 25 cents, Santa Monica reported earnings for the year ended last June 30 at $11,342.

Seattle, Wash., which has not increased its 10 cent transit fare since 1923, lost $6,660 on its operation the first seven months of this year—the first time the system has ever suffered a net operating loss on a cumulative monthly basis. Patronage of the system was off eight and one-half percent from last year.

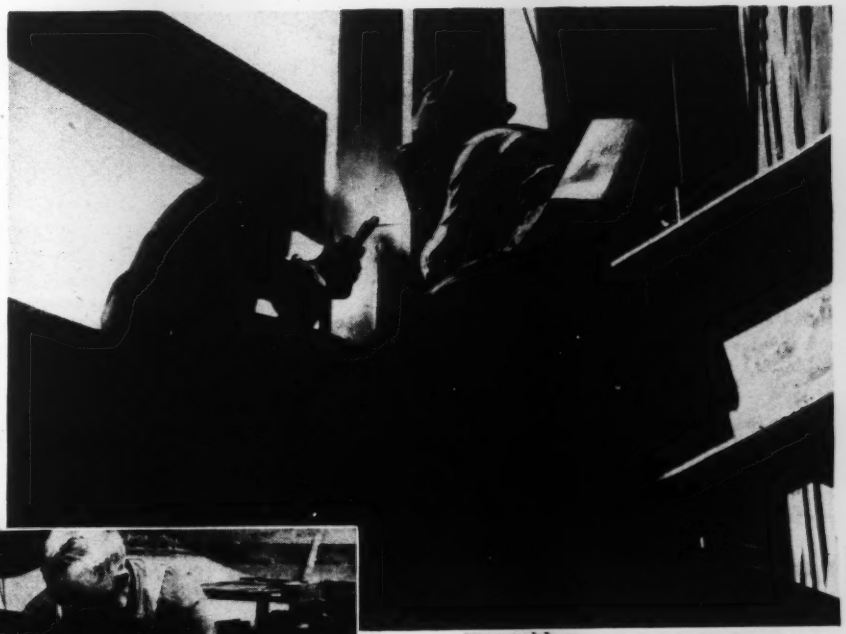
A fare increase of three cents since the end of the war failed to pull San Francisco's municipal railroad out of the red. Municipal management has asked for a tax subsidy of $1,776,703 to meet anticipated operating losses for this year.

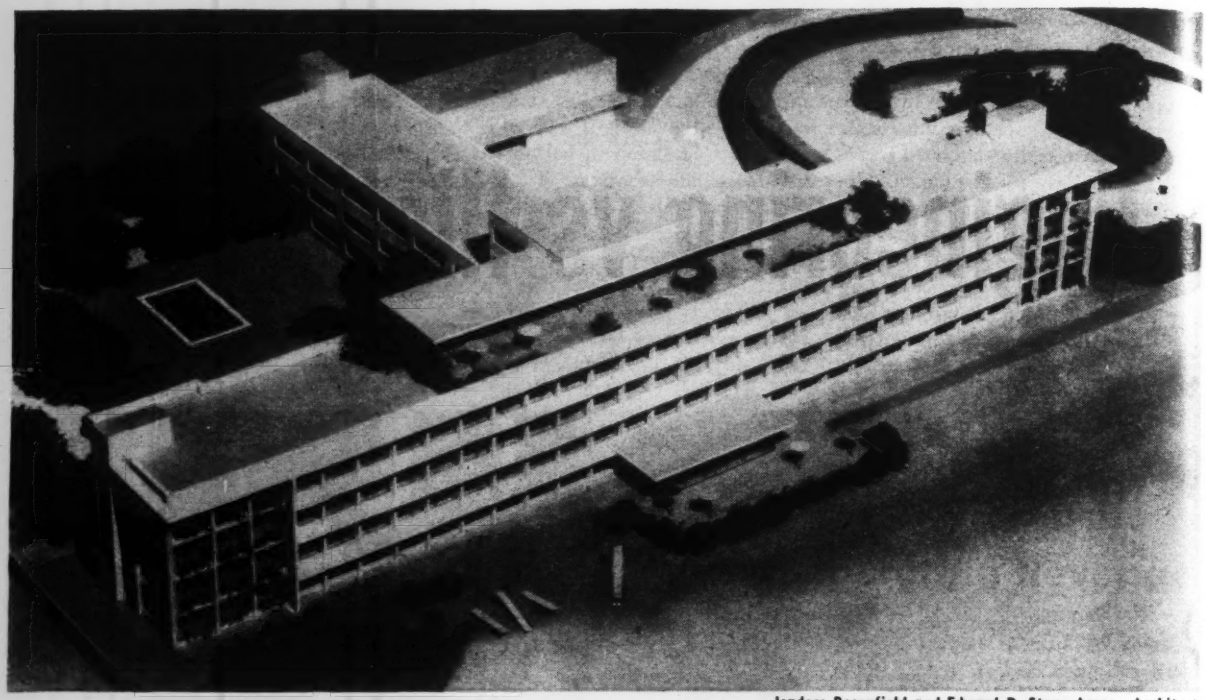
Revenues adequate

Two cities—Youngstown, Ohio and St. Petersburg, Fla.—have operated their transit lines successfully with 10 cent fares since the late 1920's. Earnings of the Youngstown transit system last year totaled $190,000. St. Petersburg's streetcars and buses annually contributed approximately $250,000 to the city's general income fund.

A SPECIAL SECTION ON BUILDINGS

Engineering vs High Costs





Isadore Rosenfield and Edward D. Stone Assoc., Architects

FIG. 1. HOSPITAL for Great Neck, L.I. Studies of hospitals such as this indicate that construction costs within reason can be achieved when nursing units are relatively large and private rooms and wards are realistically balanced.

Hospital Construction Costs Can be Cut

Isadore Rosenfield, architect and hospital consultant of New York City, believes a 50 percent reduction is possible and shows how it might be attained.

BIDS TAKEN LAST YEAR on a 200-bed tuberculosis hospital put the cost at $25,000 per bed, according to news accounts. Yet, a hospital of this size and type with a high level of accommodations, could be erected today for about half this figure.

Much of the current high cost of hospital construction may be attributed to: An unjustifiable demand for a large percentage of private rooms; excessive administrative, sanitary and recreational facilities; and inept, inexperienced planning.

Private rooms are sought after mainly for the higher income they are supposed to bring, the revenue being sorely needed to combat rising operating and maintenance costs. However, such accommodations cost more to build than other types and are an unreliable source of income, since they are first to become vacant in an economic recession. Even in prosperous periods, they might not produce adequate revenue if, as is frequently the case, the charges result in a low occupancy rate.

Recently, in planning a 100-bed community general hospital, a client indicated that one-third of the accommodations should be in wards, one-third in semi-private rooms and one-third in private rooms. I pointed out that to support 33 private rooms, the community would require at least 8,000 financially well-off people (at 4 to 5 beds per thousand). A survey indicated that incomes in that community would not justify even one private room.

Aside from what patients can afford, there is also the question of how many private rooms are requisite to the proper care of patients. The answer may be found in a study made by Doctors Goldwater and Bluestone, who concluded that only 14.4 percent of the patients in a general hospital needed such accommodations ("On Hospitals," by S. S. Goldwater, M. D., pp. 286 to 290, The Macmillan Co., New York, N. Y.).

Per-bed costs analyzed

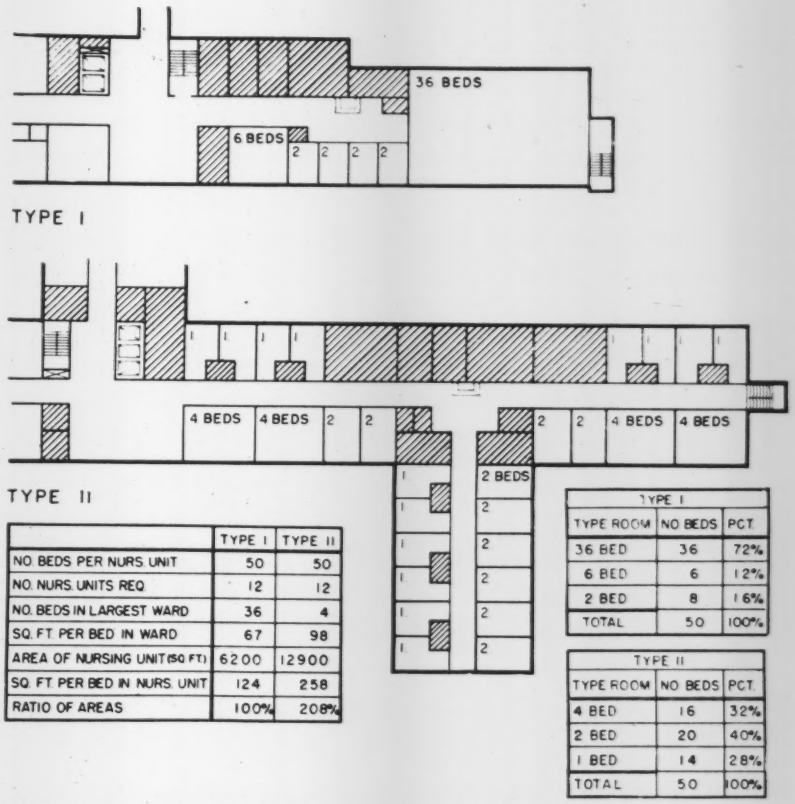
Small nursing units, with private or semi-private rooms predominating, require a larger volume of building per bed and more utilities, sanitary fixtures, partitions and doors than do large nursing units with multi-bed rooms. Consequently, a hospital with a high percentage of single-bed rooms is more expensive to build.

This conclusion is borne out by the unit costs given for eight recently designed hospital projects in the accompanying table. Their cost is computed at $1.85 per cu. ft. The first four hospitals in the table have large nursing units, each with a ward containing from 24 to 36 beds, plus a minimum of other graded accommodations. In contrast, the next group

of hospitals has small nursing units with private and semi-private rooms predominating. Only the governmental hospital has a large ward (16 beds) in its typical nursing unit.

The first group averages 3,890 cu. ft. at $7,000 per bed, with moderate fluctuations between individual hospitals, whereas the second group averages over 100 percent more than the first in volume and cost per bed.

It is also generally true that a large hospital costs less per bed than a small one. In my opinion, however, the difference in size of the hospital does not account for as much of the difference in cost as the difference in type of accommodations. This is evident when comparing the 500-bed industrial hospital with the 800-bed T. B. hospital and the 124-bed voluntary chronic in the first group. I believe that they are low in cost compared with the second group primarily because they have large wards in large nursing units and few private rooms. The psychiatric hospital in the first group shows the highest cost because, while it has large wards in each nursing unit, it also has a large number of single rooms.



	TYPE I	TYPE II
NO. BEDS PER NURS. UNIT	50	50
NO. NURS. UNITS REQ.	12	12
NO. BEDS IN LARGEST WARD	36	4
SQ. FT. PER BED IN WARD	67	98
AREA OF NURSING UNIT (SQ. FT.)	6200	12900
SQ. FT. PER BED IN NURS. UNIT	124	258
RATIO OF AREAS	100%	208%

TYPE I

TYPE ROOM	NO. BEDS	PCT.
36 BED	36	72%
6 BED	6	12%
2 BED	8	16%
TOTAL	50	100%

TYPE II

TYPE ROOM	NO. BEDS	PCT.
4 BED	16	32%
2 BED	20	40%
1 BED	14	28%
TOTAL	50	100%

FIG. 2. COMPARATIVE STUDY of floor area required for two 50-bed nursing units differing in type of room accommodations.

Wards take less area per bed

A comparison of space requirements for two types of nursing accommodations is made in Fig. 2. Type I is a minimal plan, suitable to tropical weather conditions and where the income level of the population would be extremely low. Type II represents a desirable graduation of accommodations that could be afforded by a community with a predominance of skilled industrial wage earners and a large middle class. Both types have nursing units of 50 beds, but the accommodations are quite different. Type I requires 124 sq. ft. per bed per nursing unit, while Type II takes 258 sq. ft. per bed —a difference of 108 percent.

Another comparison of space requirements is made in Fig. 3. On the second floor of a three-story hospital, the rooms contain two and four beds and 32 beds per nursing unit. On the floor above (plan not shown), in the same space, only 16 beds can be accommodated in private rooms—a 50 percent reduction in patients and a corresponding increase in cost per bed. In contrast, the first floor, with but slight increase in depth, accommodates 44 patients in four and six-bed rooms representing an increase in beds of 37.5 percent over the second floor. The cost is decreased almost by the same percentage because the increase in area, obtained by adding a 6-ft. 6-in. wide strip of floor, results in only a very slight increase in the cost of construction.

While from a construction cost point of view large nursing units containing large wards are desirable,

ESTIMATED HOSPITAL CONSTRUCTION COSTS

Hospital	Beds	Cu. Ft. Per Bed	Cost Per Bed	Ward and Room Gradations** Large	6's	4's	3's	2's	Priv.	Beds in Typical Nursing Unit
Tuberculosis	800	3,171	$5,866	36	6	..	..	8	..	50
				..	36	..	..	14	..	50
Industrial	500	3,608	6,675	24	18	..	..	4	..	46
Chronic	124	4,094	7,582	24	6	..	..	2	..	32
				36	..	..	..	..	5	41
Psychiatric	1600	4,700	7,862	24	..	..	..	..	16	40
Med.-Surg.				24	..	..	..	..	8	32
Averages	756	3,894	$6,996							
Psychiatric	96	7,543	$13,955	..	18	..	6	58	14	16 to 30
General	150	8,315	15,383	..	..	40	..	80	30	14 to 31
General	109	8,820	16,317	..	24	16	..	52	17	18 to 29
Governmental Med.-Surg.	475	11,685	21,577	16	..	12	..	..	10	38
Averages*	118	8,226	$15,218							

* Governmental medical-surgical hospital not included in these averages because of its unusual character.

** In the large hospitals, the bed breakdown is per nursing unit. In the small hospitals the entire bed capacity is broken down.

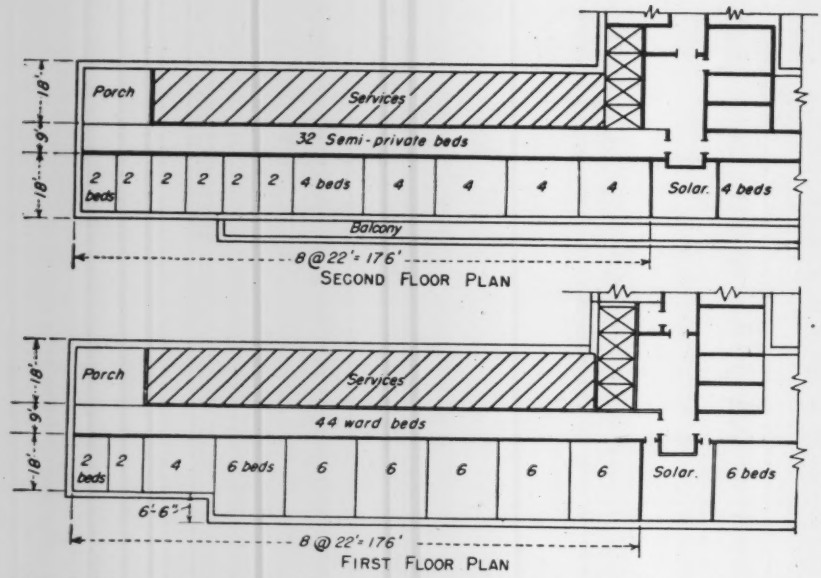
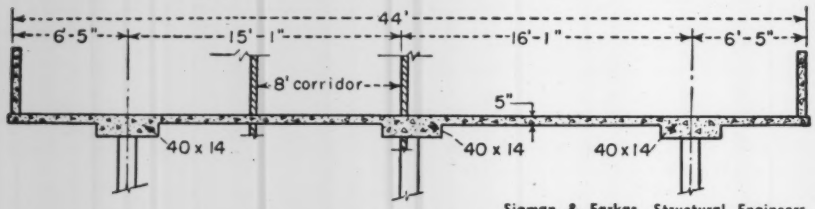


FIG. 3. Floor plans show how, with but slight increase in depth, accommodations can be increased from 32 to 44 beds.



Sigman & Farkas, Structural Engineers

FIG. 4. CONCRETE SLAB-BAND FLOOR supported on three rows of columns with cantilever is estimated to be most economical type for average spans.

it is not possible to plan 50, 100 or 150-bed general hospitals with such accommodations. Generally, the largest ward for the smaller projects would be a six-bed room, and the nursing units would also have to be small. For example, although a 500-bed hospital could have 10 nursing units of 50 beds each, a 100-bed hospital, which would need at least four nursing units—medical, surgical, maternity and pediatric—would average only 25 beds per unit. And a 50-bed hospital would have nursing units of about 12 beds.

Another factor that makes a big difference in the cost per bed is the arrangement of the beds in depth from the window. With a three-bed deep layout, costs are less than with a two-bed deep plan. The large wards and the six-bed rooms in the first group in the table are three beds deep. In the second group, the voluntary psychiatric has a few three-bed deep rooms; all others, even the 16-bed wards, are two beds deep.

In planning a hospital, the savings that can be achieved through selection of the most advantageous structural design should not be overlooked. Construction that takes a great deal of space and requires extensive furring is not economical.

Comparative studies of structural floor systems tend to favor the reinforced concrete, slab-band floors (*ENR* Oct. 17, 1946, vol. p. 526). For average hospital spans, the 3-column system with cantilevers shown in Fig. 4 appears to be most economical. The cantilevers allow considerable freedom of window arrangements, which is particularly suitable with radiant heating when the risers may be brought up at corridor partitions instead of at the perimeter of the building.

Heating, conditioning and lighting

Although radiant heating might make a hospital slightly more expensive, the cost would be amortized in a few years through savings in fuel and initial cost of the power plant. Heating coils should be in the ceiling rather than in the floor for many reasons, the principal one being that in a hospital considerable floor area is covered by beds and other furniture. The comfort to be derived from such a system of heating, at least in the patients' quarters, is more desirable than an over-expanded air-conditioning system, or an excess of private rooms.

Air conditioning is a feature of hospital design in which designers sometimes indulge beyond the means of a community. However desirable air conditioning may be in many parts of a hospital, it is imperative only in the operating and delivery suites, central surgical supply, premature nurseries, milk-formula room, and other locations that require a high degree of comfort and asepsis.

Much more necessary is the piping of oxygen to about 50 percent of the beds. This would increase the initial cost of a hospital very slightly, but would reduce maintenance costs a great deal by reducing the personnel needed for transporting heavy oxygen tanks through the building, as well as the damage frequently caused.

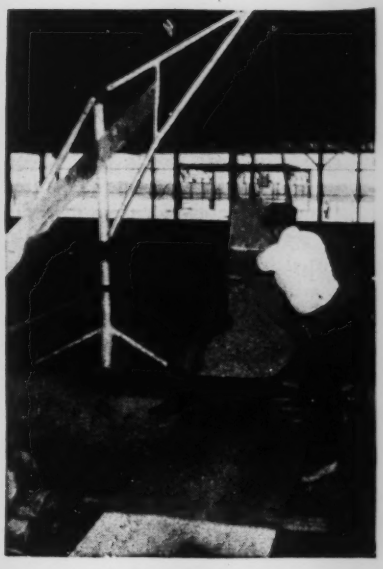
For lighting a hospital fluorescent fixtures are preferred, even though the first cost may be somewhat greater than for incandescent. The principal reason is that the former provides, at lower operating costs, a pleasant, evenly distributed light, without excessive radiation of heat.

Germicidal lamps should be used with great caution because of possible harmful effects, particularly to infants. Their use, however, is clearly indicated in the operating and delivery rooms, laboratory transfer booth, vestibules adjoining contagious disease and isolation rooms, milk-formula preparation rooms and surgical supply suites.

With careful planning, it is still possible today, even at $1.85 per cu. ft., to build certain types of governmental hospitals at a cost between $6,000 and $7,000 per bed. Medium-size voluntary hospitals with medium nursing units and a preponderance of private and semi-private beds may be constructed at from $14,000 to $17,000 per bed. No economies are suggested in diagnostic and therapeutic facilities, since these should be of the highest standards.

PUMP lifted tar to roof of plant being built at Parma, Ohio, where . . .

BUCKETS were loaded three-quarters full and carted by buggy, and an . . .



ALUMINUM DERRICK and motor-powered hoist raised slag to the roof.

Time-Saving Expedients Cut Over-all Costs of New Plants

In evaluating economy of construction, says George H. Miehls, president of Albert Kahn Associated Architects and Engineers, Inc., in this article, initial cost of materials is only part of the story—time to complete may be a determining factor in many cases.

A GREAT DEAL of emphasis is being placed on the continuously rising cost of construction, which industry has faced since the end of the war. Never before in U. S. history has construction cost so much in capital outlay. The steady upward trend in construction costs since 1939 and the acceleration thereof since the end of hostilities have been serious deterrents to the expansion of facilities—houses, factories, institutional buildings or commercial establishments.

However, although the initial capital outlay is a major factor, it is not in itself the only determinant. The cost in time to gain possession of those facilities for better living or for more efficient production and commerce is equally, if not more, important.

The lack of progressive flow of materials to the job, the critical nature of certain utility and equipment items, the scarcity of manpower, particularly in the skilled trades, and the lower productivity of labor have all tended to extend the period required for construction. There has never been a period in the history of the building industry in America when construction has cost so dearly in time. If the expense of time lost to production due to lagging construction operations were evaluated and charged as it should be to present-day costs, the indices of construction cost would reach ridiculous heights.

Saving in time is important

It becomes necessary, therefore, for architects and engineers, and the construction industry as a whole, to recognize this situation and to devise ways and means of minimizing the cost not only in initial capital expense, but in time as well. In many instances, it will be found that a saving in time is the more important factor.

The challenge has only been partly met. For example, we have not yet developed a good substitute for brick, either in appearance or in quality. Substitutes can be obtained, but in general, where a good substantial masonry wall is determined by conditions of usage, the substitution of other materials for a well-built brick wall usually means a sacrifice in quality. Yet we recognize that bricklayers, in most localities, are at a premium and therefore we are forced by this condition to eliminate brick wherever possible.

On two recent projects in Flint,

Mich., for General Motors Corp., practically all of the common brick back-up in the exterior walls was eliminated and a poured-in-place concrete wall was substituted. Although the saving in cost due to this substitution was negligible, there resulted a distinct advantage in time of occupancy by the owner. This expedient permitted installation of the sash and glass without undue delay, so that other trades that were dependent on an inclosed building could proceed with their work.

Exposed concrete is not generally acceptable in northern climates where frost action is a factor. The walls at Flint were, therefore, later veneered with brick, but in the meantime the owner was enabled to use his plant. The same construction was used in the new Chevrolet Cleveland Parts Manufacturing Plant in Parma, Ohio. Even so, the dearth of carpenters, cement and reinforcing steel are factors that must be considered in evaluating this expedient; but valuable time was saved nevertheless.

New materials save labor

There have been other facilities in which, normally, the use of brick walls would have been considered desirable. However the facts of actual use indicated that masonry walls were not essential and that substitute wall coverings served the purposes equally well. There are a number of insulated steel wall panels available on the market today that are serviceable and that can be applied to present a pleasing architectural ensemble. On a recently built laboratory, for example, in which sound deadening is important, the exterior walls are entirely of insulated steel panels, to the extent that not a single bricklayer was required on the exterior of the building.

It would appear from the foregoing that bricklayers are the bane of existence of the architect-engineer and construction contractor. It is not intended to so indicate. These constructions are used only as typical illustrations of expedients that some prevalent conditions in the building industry have made necessary.

Another example is the case of footings. Usually, the more economical foundation design for an industrial facility, assuming normal ground conditions, is the spread footing with reinforced mat and possibly a pier. Under conditions existing today, with the stringency of reinforcing steel and the scarcity of carpenters, it may be found favorable both from the standpoint of initial cost and time, to substitute a cast-in-place shallow-type caisson so designed that reinforcement and forms are entirely eliminated. With satisfactory soil conditions, the mechanized construction of such foundations, even for the light load of a one-story industrial plant, has been found worthwhile. This method has the further advantage of not disturbing the surrounding earth, making recompaction of the backfill unnecessary.

Material handling offers a challenge

Contractors have met the challenge of materials handling on buildings of large expanse by introducing mechanization to a great degree. A good example is the operations of the roofing contractor—Industrial Roofing and Sheet Metal, Inc., of Cleveland—on the Chevrolet Cleveland Parts Manufacturing Plant in Parma, Ohio, where mechanization to a greater degree than usual resulted in considerable saving of time in the roofing application.

There are 35.5 acres of roof on the single-story, steel-frame plant—31 acres of which have precast lightweight concrete tile carrying 1½-in. of insulation board, 4 plies of 15-lb. tarred felt and 4 lb. of screened roofing slag per square foot. The remaining 4.5 acres of roof, over the oven area, is steel deck, $\frac{1}{16}$ in. of asphalt-coated glass-fiber insulation, 4 plies of felt and 4 lb. of slag.

Coal-tar pitch, delivered to the job by truck, was reheated and pumped to roof level 25 ft. above the ground. Insulation board and tarred felt rolls were raised by platform elevator, and slag by a motor-powered hoist and a contractor-designed tubular aluminum swinging derrick. The tar was carried to the work site in four 5-gal. tar buckets hung on arms of three-wheel, rubber-tired asphalt carts, whereas the other materials were wheelbarrowed.

Just as mechanized production techniques developed first by the automobile industry and later adopted by other industries resulted in lower costs to the producer and ultimately to the consumer, so also will the development of such methods, wherever possible in the construction industry, result in lower costs and lower time consumption. The construction industry to date has made only a feeble endeavor in this direction. The effort will need to be made with greater emphasis in the future to reinstill the virility into the construction industry that in the past has produced production facilities with dispatch.

Not every building operation can be mechanized. We are all acquainted with modern construction methods of handling concrete from a central mixing plant; we have seen the wonders that have been worked with modern earth moving machinery. Yet, there are many operations that will continue to depend on the skills of the individual artisan, either in the shop or in the field.

Mechanization of concrete transportation and placing may be beneficial to a particular operation and may result in a saving of time for that operation, but the maximum time saving will not be realized without proper dispatch in the building and erection of forms and the setting of reinforcing steel. Prefabrication and standardization to the maximum extent is indicated.

Planned economy in design

In achieving the maximum of prefabrication and standardization, the design by the architect and the engineer is an important factor. The design should contemplate the maximum reuse of forms for concrete, the maximum reuse of drawings for structural and reinforcing steel, the maximum use of standard, modular building units, the maximum in duplication. To achieve this end, the engineer may be required to use more material in isolated locations than strength conditions dictate, but the additional material may very well be more than compensated for by the reuse of a form or by the elimination of additional shop drawings.

The engineer must associate all factors that comprise the economy or lack of it in a building operation. He may save material at the expense of labor, and too many of us do. To achieve maximum economy of design, it is necessary to analyze the overall economic aspects and strike a proper balance between the cost of material and labor and the availability of each.

Mechanizing Construction Accounting

Clifford S. Strike, president of F. H. McGraw & Co., describes the advantages his company discovered in replacing hand labor by machines in construction offices.

PAYROLL CHECKS cost us $1.25 each last year. This year, they cost only $0.72. Operating reports on equipment last year required 50 man-days per month, and they were 30 days behind. Now, only two man-days per month are needed, the reports are current, and furthermore, additional essential information is provided. These and other remarkable changes resulted when our cost accounting procedure was mechanized.

We installed the International Business Machines Corp. system in our home office for general accounting and used IBM local service bureaus near each job for payrolls. Almost completely mechanized in construction, we have found that using machines for accounting purposes also pays.

Replacement of hand labor by machines is axiomatic in most industries as a means of lowering production costs. In the construction industry, however, this principle usually has been applied only to heavy-duty equipment. Clerical work, in general, has been performed by bookkeepers, accountants, and estimators with the assistance of a few simple tools, such as typewriters, adding machines and checkwriters. Now, we are eliminating these hand operations, much as the power shovel replaced pick-and-shovel labor on large-scale excavation.

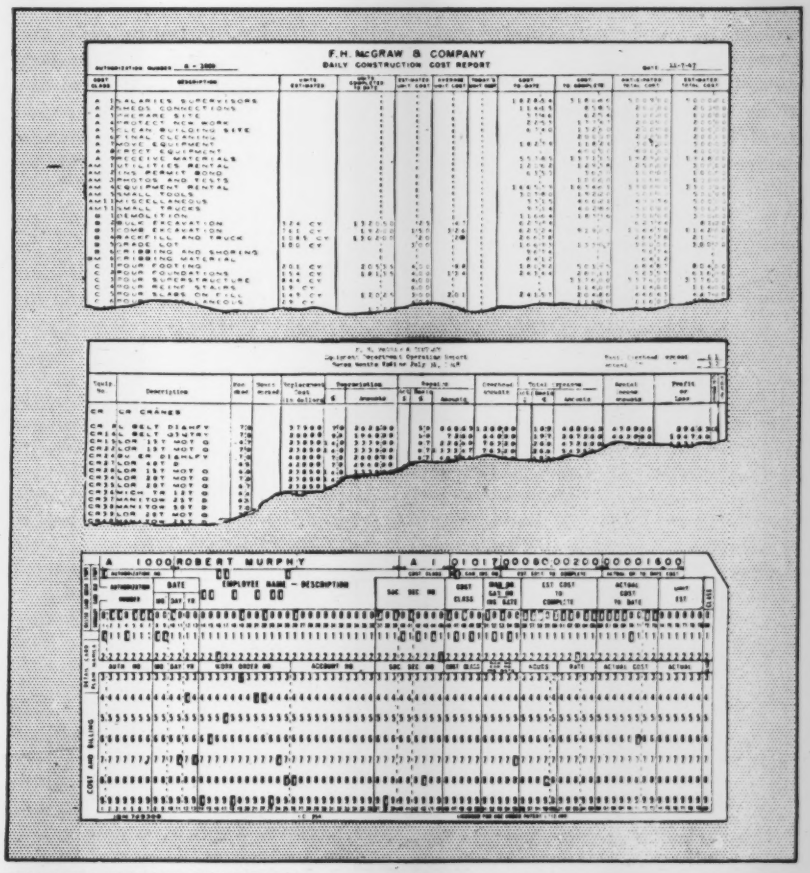
Here are some of the advantages gained through use of mechanization:

A considerable dent has been made in overhead expenses. Flexible unit records, in the form of IBM cards, make cost information available instantly. Simplified evaluation of job reports is provided for our clients as well as ourselves. Data on individuals or equipment of a particular type can be obtained almost instantly.

In the field, the payroll for a job is prepared by an IBM service bureau located in a nearby city. The records are then forwarded to our Hartford headquarters. Thus, field jobs are eliminated, and new, but fewer, jobs are created in the home office. The principal advantage of this is that the problem of finding housing for accounting personnel near each job is reduced, along with associated expenses.

Six machines, rented from IBM for installation in our home office will be sufficient to handle our volume of transactions and to obtain the desired end result. Personnel can be trained to operate the equipment efficiently in two to three weeks. They prepare social security and withholding tax records, personnel statistics, small tools inventory, equipment operating reports, labor and materials distribution data and cost analyses. These provide for each project such information as man-hours required for concrete pouring and formwork; expenditures to date; estimated cost to complete according to the original estimate; and equipment operating costs, income and time in use.

Rising construction costs have been a major concern to F. H. McGraw & Co., and we are fighting to hold them down. For the most part, it has been a losing battle. The high level of building activity has made cost reduction almost impossible. Yet in certain phases of our work, by utilizing our broad experience, maintaining the best possible labor relations and making extensive use of machines, we have been successful. Mechanization of our clerical work is a good example.



MACHINE-MADE REPORTS on detailed cost analyses, equipment operation, and personnel may be obtained at less cost than by conventional methods.

First Costs Don't Tell the Whole Story

Operating expense may dictate plant design, asserts Nomer Gray, development engineer of Walter Kidde Constructors, Inc., New York City.

BUILDINGS that are cheap to construct are not necessarily the most economical in the long run.

If the first cost is averaged over the expected useful life of the plant, the annual construction cost is only one-tenth to one-twentieth the annual cost of labor employed there. Thus, construction details must always be examined in the light of their ultimate effect on operating costs.

When new buildings are planned, designers are faced with the problem of determining which shall govern: The initial cost or the over-all cost, which includes operating costs. This problem is nowhere more strikingly exemplified than in laboratory buildings. Here a high degree of flexibility is desired because of the constantly changing nature of operations conducted in the building. Such flexibility is not achieved without cost.

In developing the plans for a laboratory for Merck and Company, Inc., manufacturing chemists, it was found that the owner preferred perfectly flat ceilings. A flat ceiling has the advantage of good appearance and of greatly facilitating shifting of partitions. He wished, however to avoid the expense of a conventional hung ceiling and associated costs, such as those due to the additional wall area arising from greater building height, additional piping and fixtures.

The owner's requirements were satisfactorily met by a reinforced concrete framing scheme involving the use of a flat slab continuous over four longitudinal concrete girders (Fig. 1). The slab spans 22 ft. on either side of a 7-ft. central aisle, and the girders are supported on concrete columns spaced 20 ft. c. to c.

This framing, typical of that used in three floors and a basement, extends transversely across a building 202 ft. long by 55 ft. wide.

With 3000-psi. concrete, the required slab thickness is 9 in. for the two 22-ft. spans. While this thickness is greater than would be required for beam-and-girder framing, the total concrete cost is very likely to be less due to savings on forms with this simple framing and reduced over-all height of building. In the corridor, where the headroom requirement is less, a hung ceiling was used, providing a space for running concealed service lines.

Another feature incorporated in this building is a modular layout of the process piping. Along the laboratory side of the corridor walls, at 10-ft. intervals, vertical pipe inclosures extending from basement to roof contain such items as hot, cold and distilled water, gas, vacuum and compressed air lines, and ventilation ducts.

An interesting feature of the column layout is the offset of the interior columns from a line connecting the centers of the exterior columns. To permit two window openings in each bay, centers of exterior columns were placed at 20-ft. intervals and alternate pipe inclosures were centered on them. Had the interior columns been placed on these center lines, they would have divided the vertical pipe inclosures into two compartments and necessitated enlarging them to permit connecting piping to pass around the column. To obviate this difficulty, the interior columns were shifted to the end of the pipe inclosure, a distance of about 30 in. Since the slab is carried by the interior longitudinal girders, such a shift is perfectly feasible.

Another case in which operating costs may control construction details is that of air-conditioned buildings. Infiltration of air through openings in exterior walls can have an adverse effect on air conditioning where special humidity control is required. It results in varying degrees of humidity and temperature near points of infiltration, which for some processes

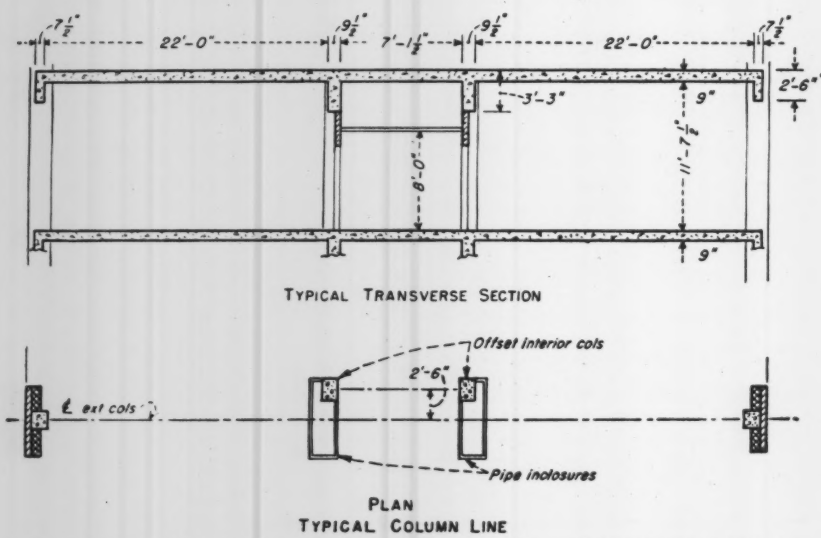
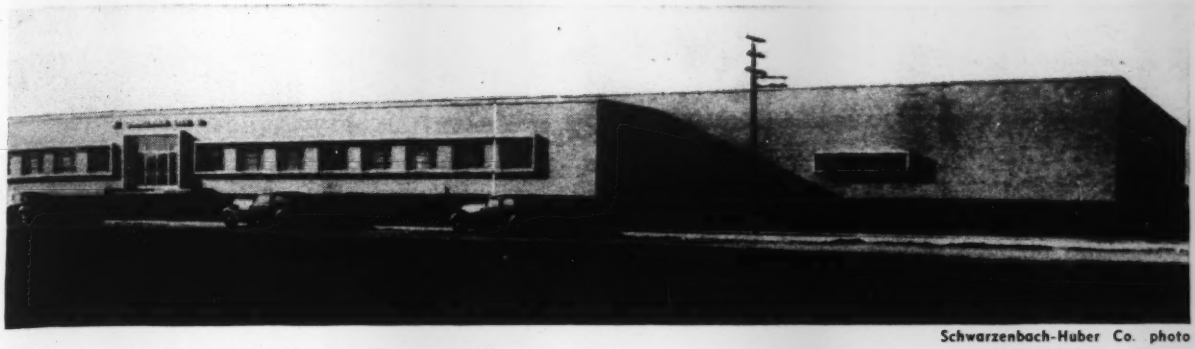


FIG. 1. A FLAT-SLAB Floor continuous over four girders eliminated a hung ceiling. Interior columns were offset to avoid dividing pipe inclosures.



Schwarzenbach-Huber Co. photo

FIG. 2. SHADOW-BOX WINDOWS (at right) are used in an air-conditioned weaving mill at Bethlehem, Pa.

are not tolerable. Similarly, varying intensities of light and heat resulting from patches of sunlight through windows are at least undesirable.

These factors were important considerations in the design and construction, during 1947, of a weaving mill at Bethlehem, Pa. Here the use of occasional shadow-box windows (Fig. 2) seems a happy solution to both problems. While not new in itself, this detail has not, in our experience, been used for this purpose previously. It minimizes troublesome infiltration and sunlight and satisfies the desire of the weavers for an occasional look at the outside world.

These windows are located in the otherwise windowless wall on either side of the office section at the front, and also in the wall at the right in Fig. 2. Details are given in Fig. 3.

Double sash is used to minimize air infiltration. The outer sash is fixed, whereas the inner sash is hinged to permit access to inner surfaces for cleaning and other purposes.

To avoid transmission of direct rays of sunlight, the windows were deepened perpendicular to the wall to 2 ft. $2\frac{1}{2}$ in. and kept to a clear height of 2 ft. 6 in. This greater window depth was achieved by the use of a concrete frame that extends 10 in. from the face of the brick.

The 16-ft. length is broken up into four spaces by vertical baffles. Since these baffles are $\frac{1}{4}$-in. plywood panels, there is no appreciable reduction of window area.

The combination of length, breadth and thickness effectively prevents strong sunlight from entering the building at any time of day in any season of the year. The relief, resulting from the 10-in. projection of the concrete frame is pleasing, and this structural detail was repeated in the treatment of the continuous sash in the office section at the front.

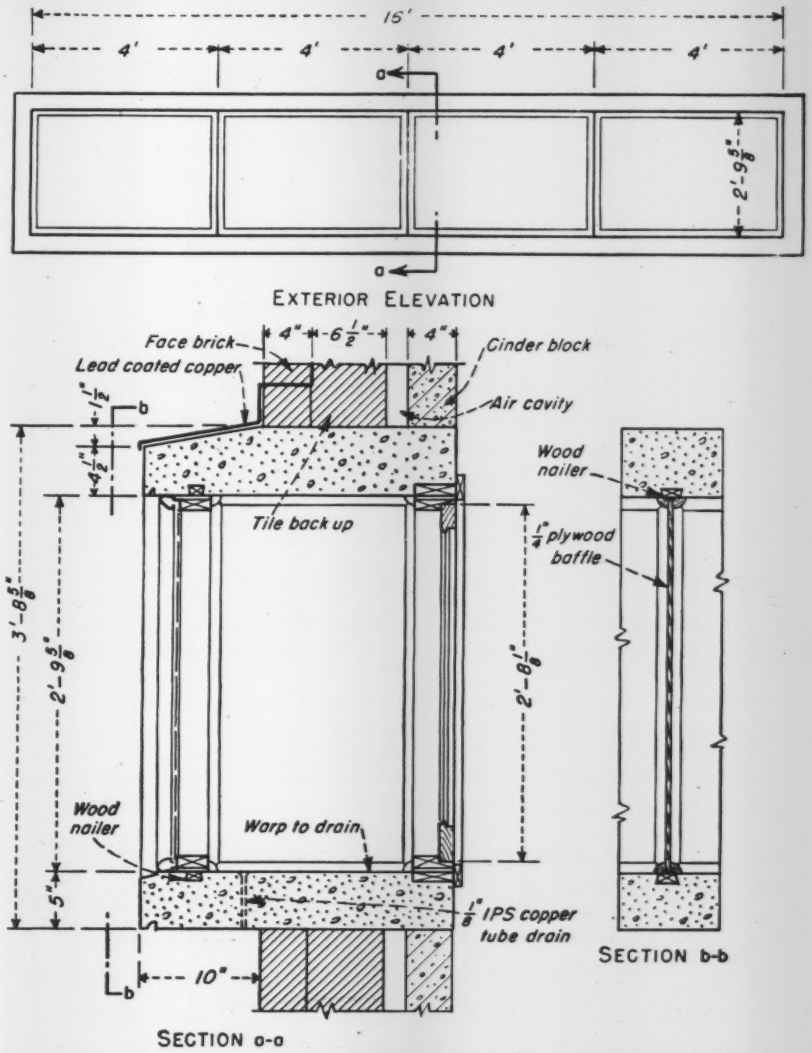


FIG. 3. A PROJECTING CONCRETE FRAME, plywood baffles and double glazing form a shadow-box window.

The plant is a rayon weaving mill of single-story construction, with a floor area of 68,000 sq. ft. It was designed and constructed for the Schwarzenbach-Huber Co., by Walter Kidde Constructors, Inc. The latter also designed, with George P. Butler as consulting architect, and is now building the Merck & Co. laboratory at Rahway, N. J.

FIG. 1. WELDED PLATE GIRDER, 66 in. deep by 126 ft. long, for a bridge over the Willimantic River, Conn.

Fabrication of welded structural members can be simplified and costs reduced by thoughtful design, says T. R. Mullen, president of Lehigh Structural Steel Co. and president of the American Institute of Steel Construction.

Welding Conserves Steel

OUR EXPERIENCE as structural steel fabricators reveals that the available supply of structural steel can be made to go much further through the use of welding. We also believe that the building industry has not yet capitalized on the full economy offered by welding and that current shortages of steel makes its adoption increasingly attractive.

In the past, use of structural welding has been curtailed by lack of technical data and experience. Today, through the American Welding Society and the American Institute of Steel Construction, ample information is easily available to every architect and engineer. In addition, many fabricators acquired valuable experience during the last war.

The labor picture also has changed. Skilled riveters apparently are in short supply; whereas, because of the training received in private industry and in the armed forces, there are many more men qualified to weld. Furthermore, research has yielded welding equipment, such as automatic welders, stud welders and squirt welders, that has decreased the importance of the operator element in obtaining sound welds and increased the efficiency and reliability of structural welding.

Although welding does not lend itself to all types of structures, substantial savings in tonnages can be effected when it is used in building up such structural elements as plate girders (Fig. 1), trusses (Fig. 3) and coal bunkers. For example, a short time after welding was permitted under the new building code in New York City, our company obtained contracts for three public schools in which we desired to substitute welded plate girders and trusses for the riveted construction shown on the contract drawings. To get permission of the Board of Education, a part of the saving was given back to the city in the form of a credit on the contract price. The credit amounted to about $1,000 for each school and the company profited a like amount by this change from riveted to welded construction. This credit, about 1 percent of the amount of the steel contract, resulted from change in design of only five plate girders in each school.

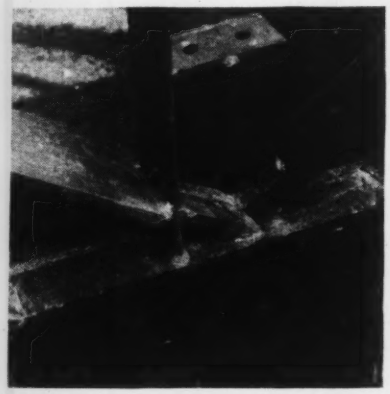


FIG. 2. BUTT WELDS hold the H-beam members of a welded roof truss at Electronics Park, N. Y.

A number of structures throughout the country prove that traditional beam and column work, with its simple connections, also can be welded. The advantage of a welded beam and column job lies in the saving of metal, not total cost.

The total cost for a welded structure with beam and column connections, such as the New York multistory buildings, is usually about the same as that for bolted and riveted construction. The total tonnage of the structure is less because welded connections use less material and thus save precious steel. But, there is no overall reduction in cost because the saving in metal is slight, and this saving is used up by a slightly increased labor cost in the shop welding.

These statements are true when welding is substituted for riveting at such points in the structure where riveting would be a requirement of the engineers of the building department. We do not imply that we can substitute welding for field bolting at the same cost, but we can, and frequently do, substitute welding for riveting in the field and save money.

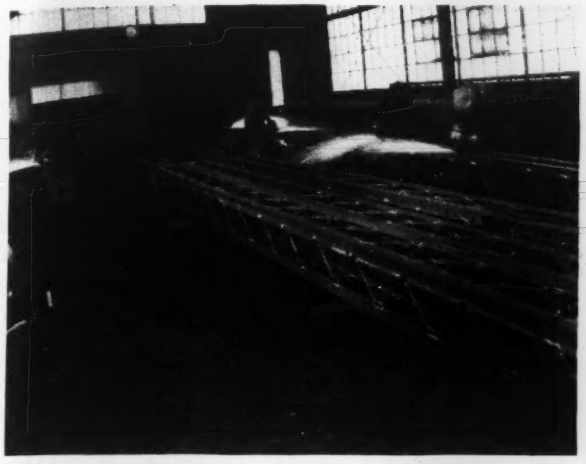


FIG. 3. SWITCHYARD TRUSSES for Consumers Power Co., Jackson, Mich., were fabricated by welding.

FIG. 4. COLUMNS for a garage in Miami were shop spliced by welding. Holes were punched only in beam seats.

For such structures as additions to hospitals, schools, court houses or other buildings where the daily business must be carried on during construction, field welding has the advantage that connections can be made quietly as compared to riveting operations. Quietness in making alterations was a distinct advantage in additions that we made to the Providence Court House in Providence, R. I., many years ago.

Alterations made easier by welding

Within the past 10 years, we have constructed additions to Bellevue Hospital connecting new steel to the old, by means of welded connections, which we suggested to the engineers as an alternative to the design originally shown. To have driven field rivets for this hospital job would have necessitated breaking the brickwork right out into some of the wards. Our suggestion merely required that the face brick covering the columns be exposed to permit us to weld connection angles to the old steel. Our suggestion was accepted and this was done. At the Jersey City Medical Center, we fabricated and erected, all by the welding method, a 21-story building amidst the existing hospital group.

There can be little argument as to the advantages of this method when the welfare of the patients is concerned. These features are worthy of consideration aside from the cost of the operation.

Welding permits compact connections, which minimize and sometimes altogether eliminate connection material. An example of this is the bottom-chord panel point of the truss in Fig. 2, in which there is no gusset plate. This characteristic has manifold implications.

For example, welding can play a vital part in erecting the tall towers needed for telecasting. These structures demand heavy footings and anchors. Since, by the use of welding, large anchoring forces can be applied to a small area, much material may be saved and design detail simplified by this method of attachment.

Elimination of rivet heads and connection material may result in more attractive structures. The plate girder in Fig. 1 is an example of the smooth surface and outline that can be obtained for highway bridges by welding. Also, as reported to us by bricklayer supervisors, brickwork covering a welded structure is simpler to lay and less costly, because such projections as rivet heads, clip angles and gusset plates are eliminated.

Hints on cutting fabrication costs

There is also a saving in shop fabrication, since handling of pieces is a large portion of fabrication cost and there is less weight and fewer pieces when welding is used. In many cases also, detail working drawings can be prepared in less time on welded work than on riveted, provided the structure has been designed for welding from its inception.

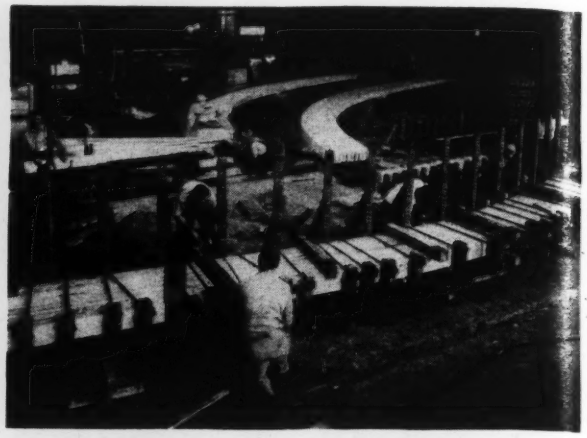
In fact, to obtain the utmost economy from welding, the designer should decide at the very start of his calculations whether to use welding or riveting. Much more material generally can be saved in a design intended primarily for welding than in one that may be either welded or riveted.

Costs are greatly increased when the design requires both welding and riveting on the same member. When the job is welded, it goes through the welding shop. If rivets are to be driven, the work must be brought into another part of the plant, and the extra handling runs up the cost.

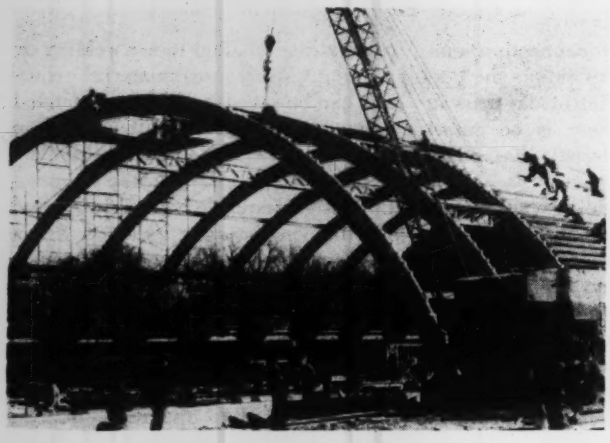
By proper design of connection details, certain shop operations may be eliminated. For example, the columns in Fig. 4 have been shop spliced without providing holes in the main elements, and the field-connection holes for the beams are in the light beam seats. This design eliminates punching and drilling of the heavy column sections and in many cases, the laying-out operation as well. As a result, the amount of handling of heavy pieces in the shop is materially reduced, and with it fabrication costs.

Attention is also drawn to the fact that structural shapes seldom conform exactly to handbook dimensions. In designing connections, therefore, the engineer should allow for mill tolerances, which are to be added to or subtracted from the handbook sizes, if the parts are to fit properly.

It is hoped that the suggestions offered here will encourage more effective use of welding. Thereby, we can make the most of our opportunity to conserve steel by welding, at a time when its supply is critically short.



SHOP FABRICATION of wood trusses and laminated beams



EXPEDITES ERECTION and spurs low-cost building

Verne Ketchum
Chief Engineer, Timber Structures, Inc.
Portland, Ore.

MANY CHANGES have occurred in timber construction in recent years to bring about lower costs. This progress was attained through a great increase in prefabrication, more widespread use of machines and refinement of techniques.

Prefabrication has been used for timber buildings in the past, but only to a limited extent. Recently, the practice has developed rapidly.

Now, we have packaged timber buildings that require but the briefest interval between delivery and occupancy. At central plants, frameworks are detailed, patterned, trimmed, routed, and bored, packaged by machinery and shipped prepared for quick assembly and erection. Knocked-down buildings, with glued-laminated arch ribs and sheet iron or aluminum roofing, can be sold for as low as $1.15 per sq. ft. (Hardware and millwork are included in this figure, but not foundations.) One such building, 40x100 ft., was recently sold for $4,500, whereas the nearest competitive bid, based on the use of other materials for the framework, was $5,500.

In addition to prefabrication of complete buildings, timber trusses and arches are being shop fabricated. Thus, timber has finally attained many of the advantages so long enjoyed by steel.

Automatic equipment now is used wherever possible in shop fabrication of trusses. High wages and lowered efficiency of field workmen have moved to eliminate the man with a saw in his hand, and in his place is the man by the whirling machine.

Prefabrication of timber trusses on large projects results in considerable cost savings. On small projects, this procedure saves time and resolves organization difficulties of the contractor, since few general contractors have experience or personnel that permit them to set up operations quickly to produce satisfactory timber trusses.

Curved-chord trusses cost less

The bowstring truss is the type most suited to timber, and its use results in strength, stiffness and savings in cost that are unobtainable with other types of timber trusses. It has a curved top chord that usually produces a curved roof surface.

Where flat or slightly sloping roofs are required, a build-up is formed by extending webs through the top chord to support a light beam conforming to the roof slope. Bowstring trusses with build-ups are nearly always more economical in cost than Pratt or Howe types.

To illustrate, a recent shopping-center building in Portland, Ore., required eighteen 50-ft. trusses. It was originally designed for the use of parallel-chord Pratt trusses. By substitution of bowstring trusses with built-up ends to give the same roof contour, the roof-framing subcontract was reduced from $9,250 to $6,465.

Sometimes, when slightly sloping roof trusses are needed, the bowstring truss can be used upside down to secure a flat roof without build-ups, and all the savings in cost inherent in this type are retained. Such inverted bow-strings are now being considered in plans for a large warehouse to be built in Portland, Ore.

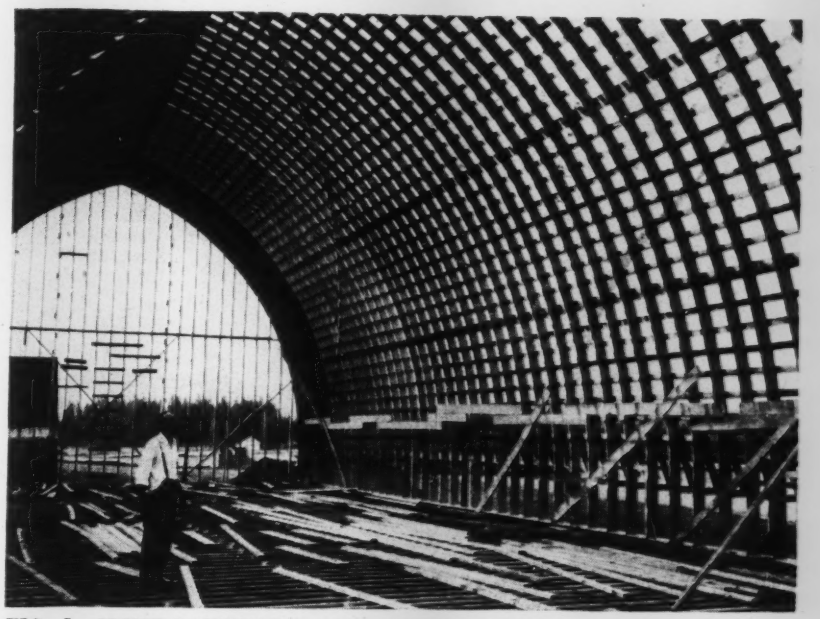


FIG. 1. GLUED-LAMINATED ARCHED RAFTERS frame a barn near Vancouver, Wash. Found economical, this type of construction is being used for a wide variety of buildings.

Laminated construction improved

The most extensive developments in timber are being made today in the field of glued-laminated construction. The war effort, scarcity of big sticks and shortage of steel were incentives that speeded improvements in techniques. As a result, members for dredge spuds as large as 3 ft. square and 90 ft. long, curved and straight truss chords, two and three-hinged arches (Fig. 1), tied-arch ribs, girders, columns and dome rings (Fig. 2) have been glued to size and shape.

With glued-laminated construction, members may be shaped to follow the snaking, twisting path of stresses or tapered to fit changing actions. They may be tailored to all those strange requirements of architectural design that baffle the reason but delight the eye. And these shapes may be produced without resorting to costly steaming, pickling and bandsawing operations that waste material, weaken the fiber and use a forest of wood and a ton of steel to carry moderate stresses around a corner.

For moderate spans, glued-laminated beams and arches in themselves are usually more expensive than solid timbers, but often other features combine to permit a cost saving in the overall picture. Reduction of hardware; absence of assembly costs, as required for trusses; easy erection and surfaces that permit exposure in locations where good appearance is a necessity—all operate to improve the competitive position of glued-laminated members.

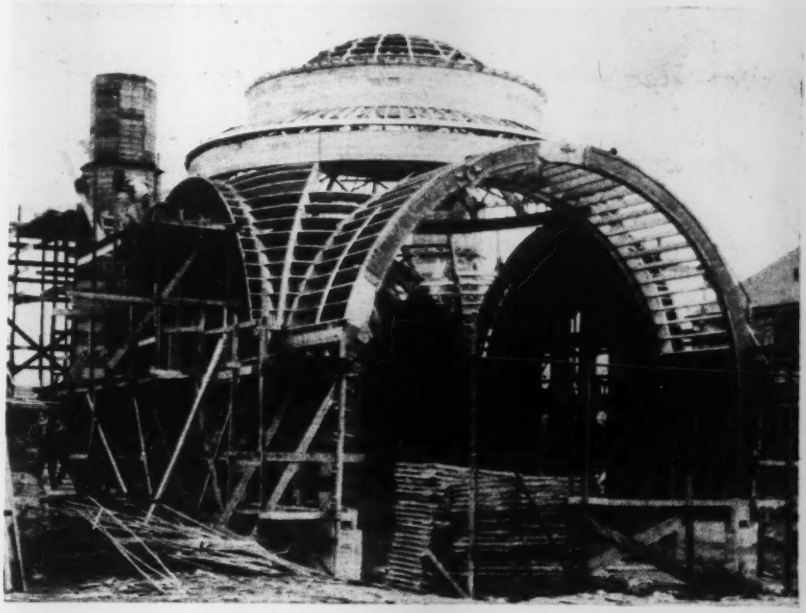
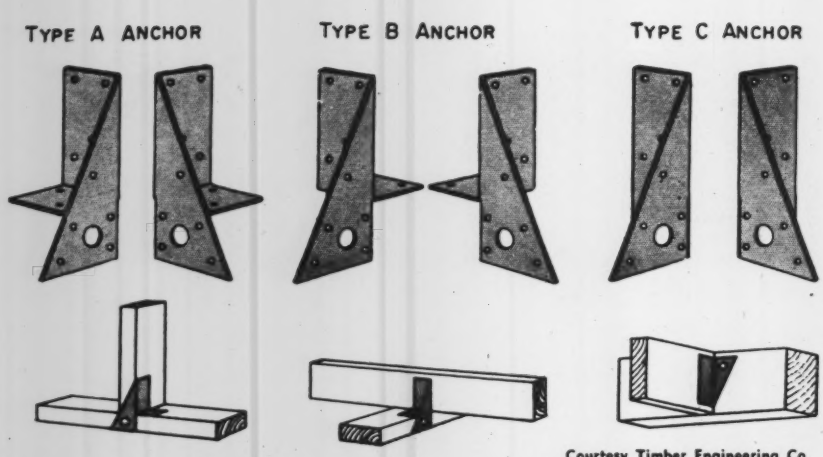


FIG. 2. ARCHES AND RINGS of a Greek Orthodox Church in Spokane, Wash., incorporating 37-ft. span arches, illustrate possibilities of ornamental curved glued-laminated timbers.

Often, expensive coverings, boxed-in construction, false ceilings and plastered or painted treatments can be omitted and the interior will give that most desired effect of exposing the structural members, omitting imitation and concealing operations. In McMinnville, Ore., a school building has been designed with solid-timber beams with boxed-in faces. By careful estimate, however, it was found that a substantial saving in cost could



Courtesy Timber Engineering Co.

FIG. 3. SHEET METAL ANCHORS have proved economical for connecting light members, such as studs and joists, where high rigidity is required.

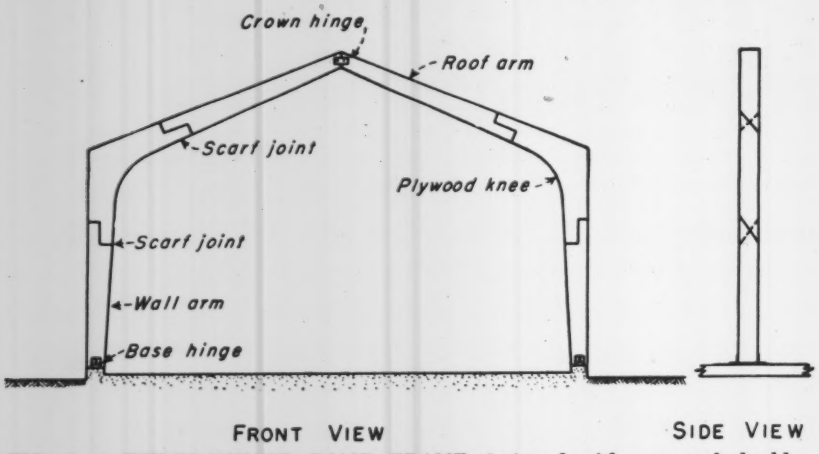


FIG. 4. A THREE-HINGED RIGID FRAME designed with patented double-scarf joints between plywood knees and roof and wall arms.

be made by the use of glued-laminated girders left exposed.

Light, arched, glued-laminated rafters are now manufactured in high-frequency electric machines, where the waterproof glue is permanently set almost in the twinkling of an eye. Laminate bundles spread with glue are fed into the machine and come out a curved, planed rafter with corners eased, ready for end trim and shipment.

Spaced at two to four-foot centers and designed as a three-hinged arch, this type of rafter has long been used in barn construction (Fig. 1), featuring elimination of eaves, lightness of members, large clear heights, wide interiors and pleasing appearance. These advantages, plus an inherent arch economy, have encouraged the use of these high-rise curved buildings for banks, theaters, amusement centers, churches and storehouses. Spans of 30 to 60 ft. are most common, and buildings of any length are feasible.

Not long ago, quotations were given for a 40x52-ft. building, completely prefabricated, to be located at Valdez, Ore. The bids revealed that a glued-laminated arched-rafter structure was $800 less than one with a trussed roof, conventional eaves and straight wall.

Recent improvements have also been made in connections for timber members. The double-bevel of split rings, for example, has been improved to increase load-carrying ability and ease of insertion. Another development is that of sheet metal anchors (Fig. 3) to fulfill a long-standing need for a simple, inexpensive connector for light pieces that are used in great numbers, such as studs, joists and rafters.

Available in various shapes with holes for fastening by nails, the anchors are especially useful where hurricane or earthquake resistance is required, or to provide rigidity where nailing is not sufficient and structural steel shapes are too heavy and too costly. In addition, they may be used in lieu of steel clip angles or wood ledgers. A comparison of anchors with steel clip angles reveals that two anchors cost about 22 cents, including nails, and two steel clip angles, with connecting bolts or lags, cost about 40 cents. Similarly, it can be shown that anchors may cost less than ledgers. For a Grape Festival building with 130-ft-glued-laminated arches now under construction at Lodi, Calif., careful cost estimates showed the anchors to be one-half the cost of the ledgers for attachment of roof joists to arches. The anchors were used.

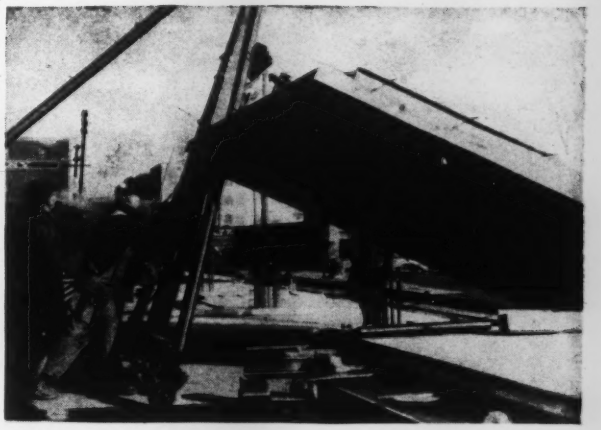
The perforated steel strap sold as a stock item by steel companies and used extensively by pipefitters for hangers can well be used also for light timber hangers, for holding-down action or to prevent separation.

Timber rigid frames

Also recently developed is an excellent type of double-bevel scarfed joint in wood, which opens to timber the whole field of rigid-frame construction. Forming a three-hinged boomerang arch, the frame has a knee of plywood and roof and wall arms of dry-solid or glued-laminated timbers (Fig. 4). Joints of arms to knee are made with the patented double-bevel scarf, which permits easy field erection and produces flush sides with no reduction in net section. A sharp curve may be used in the plywood knee, thus eliminating the use of very thin boards and the necessity of bending laminae to a small radius, both of which are costly practices. The joints permit each frame to be shipped in six sections, with little lost space.

In conclusion, it may be emphasized that no longer is lumber the only wood item delivered to the construction site. Transportation, warehousing, distributorships, and unit selling systems now bring to the consumer the finished truss, arch, frame or building that have been manufactured at a central shop, with all the cost-saving advantages inherent in mass-production operations.

BUILDING WALLS are cast on a horizontal platform and . .



TILTED into place by means of a simple erection mast.

Stretching the Concrete-Building Dollar

Arthur J. Boase, manager of the structural and railways bureau of the Portland Cement Association, Chicago, recommends several techniques that will yield better concrete construction for less money.

OPPORTUNITIES for reducing the cost of concrete construction abound in all stages of a job from early planning on. Costs may be kept to a minimum by accurately controlling the concrete mix and by selecting the most advantageous structural system and erection method.

At the inception of a job, qualified builders should be called in for conferences with the designers and inspectors. In this way, the designers will be able to take full advantage of the contractor's experience, and the inspectors will be better informed as to what is desired or how the job is to be accomplished. Such close cooperation during the design stage may develop cost-cutting suggestions and eliminate most claims for extras, which are always troublesome and expensive.

Another step that can be taken early to achieve economy is to decide on the most appropriate mix and if it is to be controlled. When accurate control is used, most building codes permit higher strength concrete. If advantage is taken of this provision, the resultant savings will more than compensate for the additional cost of control. In addition, because there will be less patching and retouching —always expensive—a far superior structure will result. To assure proper control, the concrete should be mixed and placed under the supervision of a trained concrete technician, and sufficient tests should be conducted to insure a uniform product.

For exposed work where weathering is a problem, consideration should be given to using air-entrained concrete, which has produced good results under such conditions. This also results in less bleeding and sand streaking, less segregation and honeycomb, and better workability, requiring less expenditure of labor.

When a stiff mix is specified, the concrete should be compacted by vibration. Either external or internal vibration, or both, may be used depending on the particular job. Hand spading should be eliminated where possible, although, of course, its use may be indicated in spots where accessibility is difficult.

Floors should be finished with mechanical floats, thereby reducing hand finishing to a minimum. Also, better and more durable surfaces will be obtained.

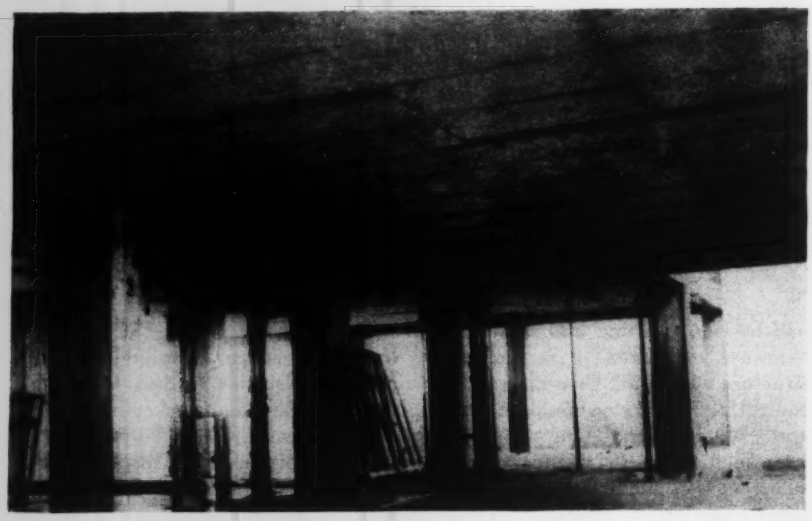
Frequently, great savings may be effected in the placing of concrete. If working space is available and the job is 14 stories or less in height, mobile cranes and buckets should be used for transporting the concrete to the place of deposit. This will eliminate hoists, runways and associated shoring, and the time and labor involved in wheeling buggies.

Helpful hints for designers

Buildings over two stories high should have a skeleton frame. This type of construction, even for very low buildings, has many advantages over bearing walls. Cost will be no greater and the resulting building will be tied together better. The job will be cleaner and will proceed just as fast, since there will be much less interference between various trades. For the same depth, floors will be stiffer and thus, deflections smaller. As a result, there will be less cracking of partitions.

When the frame is designed, the following recommendations should be given careful consideration: Calculations should be as accurate as is compatible with known data. The possibility of using high-strength concrete, especially in the columns,

FACTORY-MADE PRECAST MEMBERS are shipped to the job and erected much like structural steel.



FLAT SLAB FLOORS without capitals or drop panels cost less than slab-and-beam construction in the Clinton Hill project, Brooklyn, N. Y.

should be investigated. The floor-framing plan selected should keep story heights at a minimum, permit easy installation of ducts and conduits, eliminate need for plaster and require simple formwork.

Form costs always account for a major portion of the total cost of concrete construction. Where forms are eliminated, simplified or reused, appreciable savings result. This is especially true at a time of material and labor shortages and consequent high costs, such as exists at present. Thus, when the dimensions of members are selected, advantage should be taken of full-size commercial lumber to eliminate an undue amount of cutting and waste. At the same time, depths should be chosen to accommodate uniform height of shores.

The Clinton Hill Housing Development in Brooklyn, N. Y., is a splendid example of an economically framed job that met all architectural requirements. The project consisted of eleven buildings from 12 to 14 stories high. For the first three buildings, one-way slab-and-beam construction was used. Later on, to save form lumber, the design was changed to flat-plate construction, with floors of uniform thickness and prismatic columns without capitals or drop panels. The absence of projections below the floor slab provided uniform clear story height and gave complete freedom in locating partitions and routing piping.

Contractor's costs based on frame and floors showed the flat-plate construction to be about 10 percent cheaper than the slab-and-beam design for the same building. This figure does not include associated economies, such as those accruing from uniform height of partitions and a reduction of 2 in. in story height.

While no special shear device was embedded in the slab in the Clinton Hill project, some such reinforcement should be considered in flat-plate construction because of possible economies. The prefabricated shearhead shown in an accompanying illustration may be used for this purpose. It can be designed to satisfy any code and can be made by all bar companies. Any number of units can be used and spaced so as to reinforce against computed diagonal tension.

Slab-band floors as used in the Elliott and Brownsville Houses of the New York City Housing Authority (*ENR* April 17, 1947, vol. p. 584 and Aug. 21, 1947, vol. p. 272) also have been found less costly than other types. Here flat-plate construction was used having a strip extending between columns thickened to form a wide, shallow beam.

It should not be assumed, however, that for any one type of building occupancy, the same framing system should be always used. On the contrary, every job presents a challenge to the designer that can be taken up fruitfully only when all conditions to be met have been given due consideration.

Precasting has advanced

The art of precasting, after more than 30 years of development, has now reached the stage where it can compete with cast-in-place concrete under some conditions. Precasting is considered either a factory or an on-site operation.

In the former case, raw materials are brought to a plant for manufacture into various types of members, such as columns, beams, wall panels, and floor and roof slabs. Then, the precast elements are shipped to the building site for assembly, much in the manner of structural steel. A building recently erected in Alexandria, Va., is a typical example. The structural frame, roof decking and side wall enclosures were fabricated in a factory at Pittsburgh by the Cemenstone Corp., shipped by rail to

the site and there completely erected, within three months from the time of the taking of the order. Exact figures are not available as to savings, but the job was won in direct competition with structural steel.

The brackets and other details used on this job show the influence of steel thinking. Joists, for example, are simply supported. In contrast, full advantage is taken of continuity in a type of precasting now in use in the Argentine (see drawing) much as is done in cast-in-place construction. Elimination of brackets gives a much neater appearing job, and continuous construction offers the possibility of lower costs.

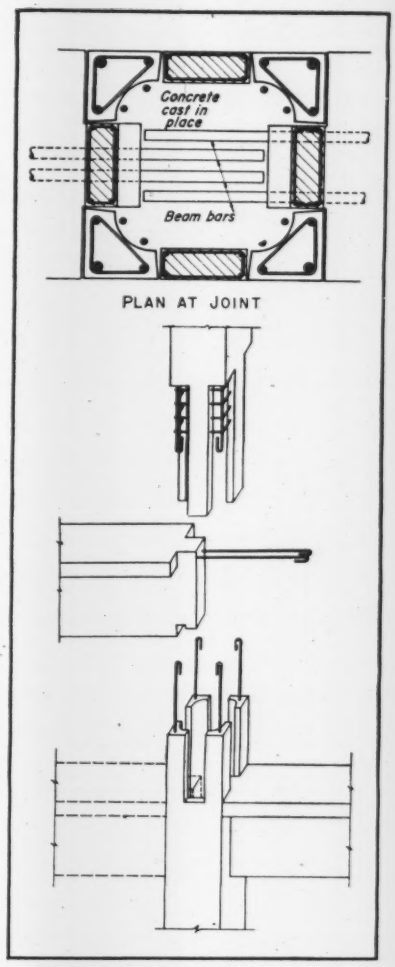
The second type, precasting on the site, permits shipping of bulk raw materials to the job and less handling of the finished product. Advocates of this method also claim lower costs.

A good example of on-site precasting was described in *ENR* April 18, 1946, vol. p. 546. The structure to which this technique was applied is now the largest precast building in the United States. It was designed by the Bureau of Yards and Docks, Navy Department, and erected by Corbetta Construction Co., New York City. The members were cast hollow with very thin walls, allowing an unusually small concrete coverage over the reinforcing steel. About 24 hr. after concrete was poured, the members were removed from the molds with suction pads and transported to a storage yard for curing. Later, they were lifted with slings from a crane for placement in the building.

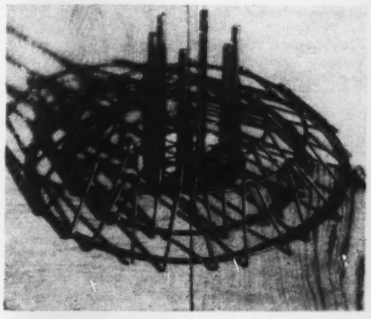
Walls tilted into place

Another type of on-site precasting now enjoying deserved popularity is known as tilt-up construction. This method of erecting walls is at least 20 years old, but present shortages of lumber and high prices of labor have encouraged its use. Although this technique generally has been confined to one-story buildings, it can be profitably applied to multi-story structures. One example is a three-story and basement building recently completed in Des Moines, Iowa. Wall panels are 17 ft. 6 in. long, first-floor panels 15 ft. high, and second and third-floor panels 11 ft. high.

On most tilt-up jobs, wall panels are cast in a horizontal position in edge forms set on the finished concrete floor, which is oiled before pouring concrete. The slabs are then tilted into position by means of a winch or crane. On the Des Moines job, however, platforms were used for casting and raising the panels. There were four of these platforms, all mounted on caster wheels for ease of moving when being tilted into position. They were lifted by a manually operated winch on a caster-mounted raising mast.



CONNECTION DETAILS of precast columns and beams used in the Argentine.



SHEARHEAD proposed for use in flat-slab reinforced concrete floors.

Each platform was pin-hinged at the exterior wall end to a structural member attached to the building floor by preset bolts. The erection mast was similarly hinged and anchored at the mast bottom adjacent to the inside edge of the platform.

To keep the panel from sliding on the platform when being tilted into vertical position, two ½-in. round bars, at about the outside quarter points along the top wall edge, were extended from the edge forms and slipped through slotted structural members on the casting platform. A collar on each bar, held with set screws, bore against the slotted members. After vertical positioning of a panel, the collars were removed and the bars bent inward to bond into the floor or roof slab at the top edge of the wall. Winter schedules called for erection of two panels per day, but in warm weather this was stepped up to four.

Following the erection of wall panels on each floor, column forms and shores for the next floor were set and concrete placed. The operation of casting wall panels and tilting into position was then repeated on the floor above. All equipment used for this type of construction is very simple and available in practically every community.

Architectural concrete walls are being tilted into place to inclose an eight-story office building now being erected in Columbia, S. C. Preliminary figures indicate a saving over conventional methods of erection.

At present, precasting is hampered in many parts of the country by excessively restrictive building codes. If regulations can be kept abreast of field progress, precasting will be found an economical type of construction.

Many people today criticize the construction industry for not being more progressive and not advancing as rapidly as other industries. Nevertheless, American architects, engineers and contractors have made great strides. Under the conditions they face, they can build faster, better and give more for the client's money than any like group anywhere in the world.

READER COMMENT

Comparative Transit Table

Sir: The article by C. O. Greenwood, Jr. on the use of an optical theodolite in dam surveys (*ENR* June 10, p. 94) is of special interest in Latin America, where the Swiss instruments compete in price with American-made transits.

One item which is not clear in the article is that it refers exclusively to the T-2 (Universal Theodolite) manufactured by Wild (Heerbrugg, Switzerland). European manufacturers are very individualistic, and their instruments are not at all standardized. Therefore it is quite difficult to select a transit or theodolite, as no two instruments are easily comparable.

Recently one had to be selected for irrigation surveys in the Cauca Valley of Colombia. For this purpose we prepared a table that may be found useful by your readers; it includes the standard Gurley, K & E, Kern (Swiss), and Wild (Swiss) instruments for the range of precision usually required. Optical centering is available with all Wild and Kern instruments.

CARLOS S. OSPINA
Consulting Engineer
Cali, Colombia, S. A.

Engineers and Soil Conservation

Sir: I find the caption, "Dim Future", to the item (*ENR* Sept. 23, 1948, p. 1) relating to what scientists say with respect to land conservation, disturbing. It might well have been "not-so-dim future".

The item itself concerns a subject which may well be taken seriously, and it is well written. But the "Dim Future" caption creates the impression in my mind that you aren't particularly concerned, but are just tossing out a random idea in case someone should be interested.

I believe one of the greatest public services that any publication, (and particularly one having the standing yours has in the engineering world) could undertake would be to adopt a strong and sustained editorial policy of pushing conservation to the limit. If you doubt it, look at almost any picture of China. It *can* happen here. It *is* happening here! And the engineer can do as much as anyone to stop it, if he can be made to see the necessity of doing so.

Beaver dams and grass covered hills don't make interesting pictures or articles for publication, but enough of them would make many bigger and better dams unnecessary, and engineers could spend more time fishing and less time making names for themselves as dam builders.

And we all like to eat—and must to survive. It's a simple formula—"More people plus fewer acres of less fertile soil equals less food."

T. A. DOWNING
Highway Design and Plans Engineer
Idaho Bureau of Highways, and
Chairman, Board of Supervisors
Dry Creek Soil Conservation District, Idaho.

Engineers in Railway Work

Sir: I have been particularly interested in your editorials and correspondence in recent issues, on the recruitment of engineers for U. S. railways and the high executive posts which are frequently occupied by senior engineers.

We have, of course, had to face a similar problem over here resulting from cessation of new construction, but for a considerably longer period than you have in America. Similarly, in India, we also found that nearly always the engineers made the best chief executives, and, prior to the handing over and partition of the subcontinent, about 90 percent of the general managers of Class I Railways were engineers, apart from those lines that are in Indian sovereign (princes') states.

We greatly value *ENR* here on *The Railway Gazette*, and I believe, lose no opportunity of handing on to our readers any information in articles likely to be of interest to them as railwaymen.

F. S. BOND
Civil Engineering Consultant
The Railway Gazette.
London

COMPARISON OF TRANSITS AND THEODOLITES

	1	2	3	4	5	6	7	8	9	10	11	12
Telescope												
Length, inches	12	10	10	8.5	5.8	5.8	10.4			11.5	12	13.5
Type (a)	e	e	e	i	i	i	i	i	i	e	i	i
Magnification	27	22	22	17	28	28	24-30-40	20	30	24	28	24-32
Aperture, inches	1.57	1.37	1.37	1.19	1.6	1.6	2.4	1.18	1.77			
Horizontal Limb												
Diameter, inches	6.25	5.65	6.25	5.125	3.1	3.6	5.6	2	3	6.25	7	8
Division (b)	30′	30′	30′	30′	1°	20′	4′	20′	10′	20′	10′	10′
Reading to	1′	1′	1′	1′	1′	1″	.2″	10″	1″	30″	10″	10″
Estimated to					1′	.1″		1″	.1″			
Vertical Limb												
Diameter, inches	5	5	5	5	2.8	2.7	3.8	2	2.75	5	5	5.5
Division (b)	30′	30′	30′	30′	1°	20′	8′	20′	10′	30′	20′	15′
Reading to	1′(c)	1′	1′(c)	1′	1′	1″	.2″	10″	1″	1′	30″	20″
Estimated to					1′	.1″		1″	.1			
Compass												
With Instrument	3½	4½	3½	3½						4½		
Extra					√	√		√	√			
Not provided							√				√	
Weight												
Instrument, lbs	13.25	11.5	12.25	10.5	10.7	12	24.2	4	8	15.5	19	23
In Box, lbs	25	22.5	21.5	19	14.4	17.5	32.5	6.2	11.9	26	33	37
With Tripod, lbs	37	33	33	30	25	26.3-32.5	49.0	12	20			

1—Gurley No. 52, Hell Gate Precise Transit—Engineers Model
2—Gurley No. 82 · Hell Gate Precise Transit—Mountain & Mining Model
3—GurleyNo. 132R, Standard Precise Transit—Engineers Model
4—Gurley No.112R, Standard Precise Transit—Reconnoissance Model
5—Wild T1, Repeater Theodolite
6—Wild T2, Universal Theodolite
7—Wild T3, Precise Theodolite
8—Kern DKM1, Small Triangulation Theodolite
9—Kern DKM2, Triangulation Theodolite
10—K & E 5060FS, Engineers Transit
11—K & E 5086V, Municipal Triangulation Theodolite
12—K & E 5088, Repeating Theodolite for Triangulation

(a) e: Erecting i; Inverting
(b) The Swiss Instruments frequently have a micrometer drum
(c) These models also may be divided for 30 or 20-second vernier reading

UNIT PRICES BID BY CONTRACTORS

Navigation Lock and Spillway, McNary Dam, Washington

OWNER: Department of the Army, Corps of Engineers, Portland, Oregon; Colonel O. E. Walsh, district engineer.

PROJECT: Construction of a major portion of the navigation lock, abutment embankment, fishways, a portion of the spillway dam and other appurtenant structures on a section of McNary Dam adjacent to the north shore of the Columbia River, approximately 3 miles upstream from the town of Plymouth, Benton County, Washington.

CONDITIONS: Contractor to furnish all plant, materials, equipment, supplies, labor and transportation, including fuel, power, and water. Stipulated contract time is from ten days of the notice to proceed to June 30, 1950. Access to the job site is available by railroad and highway, the government to supply housing for the workers at the job site. Minimum wage rates are: bricklayers, $2.50 per hour; cement finishers, $1.825; iron workers, $2.058; heavy construction workers, $1.35; and power equipment operators range from a low of $1.45 for equipment oilers to $2.35 for power shovel operators.

LIST OF BIDDERS: *Contract awarded August, 1948

1.* Guy F. Atkinson Co., Ostrander Construction Co., J. A. Jones Construction Co., Portland, Oregon $21,648,763.00
2. Consolidated Builders Inc., Portland, Oregon 29,033,378.00
3. J. A. Terteling & Sons, Inc. 43,676,873.75

	Item	Quantity	Unit Prices Estimate	*(1)	(2)
	Excavation and Embankment				
1	Stripping borrow areas	4,500 cy	0.53	0.70	1.17
2	Common excavation	121,000 cy	0.93	1.20	1.60
3	Foundation cleanup of abut. area	10,000 sy	1.71	1.50	5.50
4	Rock excav. of abut. foundation	1,200 cy	1.75	5.00	10.50
5	Borrow for impervious core	75,000 cy	1.24	1.00	1.80
6	Excavation from stock-piles	5,000 cy	1.48	1.25	2.00
7	Excavation from coffer dams	160,000 cy	0.83	1.35	2.15
9	Rock excav. for spillway and non-overflow dams	370,000 cy	1.69	4.16	4.40
10	Rock excavation for fishway	20,000 cy	5.06	4.16	6.00
11	Rock excav. for navigation lock	40,000 cy	3.64	5.00	6.00
12	Rock excav. for lock appr. chan.	140,000 cy	3.43	1.50	3.50
13	Rock excav. for guard walls, moorage	10,000 cy	4.15	5.00	10.50
14	Rock excav. for railroad spur	100 cy	2.98	3.50	9.50
15	Selected stone revet., in place	5,000 cy	0.67	1.30	2.30
16	Rock fill, in place	226,500 cy	0.37	0.60	0.70
17	Spalls, in place	11,000 cy	0.37	3.00	1.60
18	Sand and grav. filter in place	4,400 cy	2.30	5.60	6.65
19	Sand filter, in place	4,500 cy	3.87	5.60	6.65
20	Gravel filter, in place	3,100 cy	3.63	5.60	6.65
21	Impervious core, in place	51,500 cy	0.38	0.75	0.90
22	Ramdom fill, in place	347,000 cy	0.11	0.15	0.30
23	Additional rolling, two passes	5,000 M sf	0.25	0.25	0.33
24	Sprinkling	13,000 M gal	2.31	2.25	3.35
25	Concrete for foundation surface for impervious core, in place	500 cy	28.25	15.00	26.70
	Cofferdams				
26	Cofferdam pumping	15,000 af	6.19	1.44	19.80
27	Sandbags for cofferdam bulkhead, in place	15,000 bag	1.51	0.80	1.15
28	Remov. and stor. of steel sheet piling	1,100 ea	8.60	20.00	36.00
	Temporary Fishladders and Bulkheads				
29	Rock excav. for temporary fishladders	300 cy	4.49	9.75	11.00
30	Plac. impervious fill in bulkhead	8,300 cy	0.53	1.00	1.05
31	Bank run grav. or rockfill in bulkhead	19,000 cy	1.87	1.00	0.55
32	Rockfill in bottom of bulkhead, rock cap	7,000 cy	0.66	1.00	0.80
33	Miscell. metal in temporary fishways, bulkheads	10,000 lb	0.41	0.60	0.55
34	Timber in bulkhead	1,400 M f bm	199.10	160.00	259.00
35	Lumber and timber in temporary fishladders	740 M f bm	242.88	175.00	319.00
36	Plac. steel sheet piling in temporary fishladders	100 ton	15.76	50.00	165.00
37	Gates for temporary fishladders, in place	34 ea	55.91	185.00	107.00
38	Timber piling, untr., in place	25,000 lf	1.38	1.60	2.30
40	Timber in grout stop recess	16 M f bm	188.31	200.00	430.00
	Foundation Exploration and Grouting				
41	Drill. EX holes, depth 0 ft.-90 ft.	32,000 lf	2.68	2.70	3.00
42	Drill. EX holes, depth over 90 ft.	4,500 lf	3.40	3.50	3.40
43	Drill. NX holes, depth 0 ft.-100 ft.	2,000 lf	7.55	8.00	15.10
44	Drill. NX holes depth over 100 ft.	2,000 lf	9.00	9.00	16.55
45	Drill. wagon drill holes, depth 0 ft.-35 ft	3,000 lf	2.35	1.60	2.00
46	Drill. calyx holes, (36 in. diam.) depth 0 ft.-50 ft	100 lf	97.10	90.00	70.00
47	Drill. calyx holes, (36 in. diam.) depth over 50 ft	150 lf	172.62	110.00	105.00
48	Drill. 6 in. diam. holes, depth 0 ft.-100 ft	600 lf	15.79	17.00	45.00
50	Drill. 6 in. diam. holes, depth over 100 ft	500 lf	16.87	20.00	45.00
51	Drill. through overburden	150 lf	9.81	10.00	23.00
52	Pressure grouting	27,000 bag	2.24	1.50	4.30
52a	Min. payment for pump conn. pressure grouting	60 job	5.00	5.00	5.00
53	Miscell. pipe, fittings and valves for grouting and drainage, in place	45,000 lb	0.44	0.44	0.50
	Concrete Work				
54	Mass concr. for spillway and non-overflow dams, in place	140,000 cy	8.07	8.80	12.75
55	Concr. for piers, in place	45,000 cy	38.24	15.00	25.75
56	Concr. for apron, in place	47,000 cy	11.96	14.00	13.75
57	Concr. for bridges, in place	1,300 cy	108.68	70.00	105.00
58	Concr. for fishladder, section 1-18 incl., in place	22,000 cy	63.16	48.00	70.00
59	Concr. for a fishladder section 19-24 incl., in place	12,000 cy	52.51	25.00	48.00
60	Mass concr. for navigation lock, in place	300,000 cy	10.47	8.80	12.15
60a	Concr. for navigation lock filling, emptying culv., in place	44,000 cy	21.85	18.00	16.50
61	Concr. for bottom lateral, discharge sys., in place	4,100 cy	68.51	32.00	63.00
62	Struct. concr. for navigation lock, in place	4,500 cy	55.62	65.00	100.00
63	Concr. for upstream guard wall "A", in place	12,000 cy	32.95	15.00	19.75
64	Concr. for upstream guard wall "B" & "C", in place	78,000 cy	19.49	16.50	25.75
65	Concr. for downstream guard wall "A" & "B", in place	33,000 cy	15.08	19.00	21.25
66	Concr. for downstream guard wall "C", in place	5,000 cy	53.82	50.00	56.00
67	Concr. for moorage, in place	5,000 cy	41.32	48.00	60.00
68	Concr. backfill for moorage, downstream guard wall, in place	3,000 cy	12.27	9.00	10.00
69	Concr. for temporary fishladder, in place	700 cy	15.83	30.00	22.00
70	Struct. concr. for spillway and non-overflow dam, in place	4,000 cy	62.23	40.00	93.00
71	Sawdust concr., in place	10 cy	49.33	60.00	150.00
72	Steel reinf., in place	7,000 M lb	0.132	0.10	0.11
72a	Reimbursement for steel reinf. purchased and del. f.o.b. cars, site of work, under Govt. supply contract	lump sum	293,670.00	293,670.00	293,670.00
72b	Handling and placing reinf. steel incl. in Govt. supply contract	6,000 M lb	0.0753	0.05	0.046
73	Metal fabric, in place	2,000 lb	0.42	0.35	0.30
74	Copper water stops, in place	21,000 lb	1.18	1.50	2.30
76	6 in. diam. porous concr. drain tile, in place	1,300 lf	2.94	2.65	1.70
77	8 in. diam. drain tile, in place	8,400 lf	1.98	1.15	1.85
78	8 in. black steel pipe for apron drainage sys., in place	500 lf	5.19	6.00	8.80
79	Vacuum treatment for concr.	28,000 sy	6.27	2.95	5.75
80	Tile gages, in place	245 lf	20.40	20.00	30.00
81	Drilling and grouting anchor bars	57,000 lf	1.33	1.00	2.15
82	Asphalt seals, in place	9 ton	260.89	220.00	620.00
	Cement				
83	Portland cement, Type II, or Type II-A, low alkali content	663,000 bbl	4.59	4.75	5.17
	Temporary Miter Gate Operating Machinery				
87	Temporary miter gate, in place	lump sum	40,700.00	60,000.00	57,600.00
	Structural Steel and Miscellaneous Metal Work				
90	Struct. steel for guides, in place	2,400 M lb	0.242	0.225	0.365
91	Corrosion—resisting steel, in place	80,000 lb	0.227	1.10	1.35
92	Struct. steel for spillway gate tr., in place	800,000 lb	0.271	0.22	0.33
93	Steel tread plates for spillway gate tr., in place	200,000 lb	0.4683	0.40	0.60
94	Tr. for gantry cranes, in place	200,000 lb	0.112	0.18	0.19
95	Struct. steel for br. and towers, in place	3,300 M lb	0.1584	0.195	0.25

Continued on page 116

Navigation Lock and Spillway McNary Dam, Washington

Continued from page 115

96	Floating mooring bitt, compl., in place	8 ea	1,250.16	2,600.00	2,375.00
97	Miscellaneous struct. steel, in place	270,000 lb	0.20	0.29	0.40
98	Guides for floating mooring bitts, in place	170,000 lb	0.359	0.35	0.40
99	C. I. castings, in place	24,000 lb	0.380	0.66	0.60
100	Steel pipe hand railing, in place	160,000 lb	0.387	0.55	0.57
101	Wall armoring and protection angles, in place	790,000 lb	0.181	0.28	0.40
103	Miscell. metal, in place	550,000 lb	0.246	0.35	0.55
104	Steel stairs and ladders, in place	60,000 lb	0.311	0.44	0.50
105	Aluminum handrailing, in place	4,000 lb	2.17	3.30	4.30
106	Industrial type door, in place	13 ea	121.62	250.00	360.00
	Installation of Government Furnished Equipment				
107	Install. of culv. tainter valves and operating mach	lump sum	20,988.00	20,600.00	32,400.00
108	Install. of slide valves	lump sum	17,013.00	25,000.00	12,700.00
	Electrical Work				
109	4 in. galv. conduit and fittings	500 lf	2.40	4.70	4.90
110	3 in. galv. conduit and fittings	1,500 lf	1.76	3.60	3.30
111	2 in. galv. conduit and fittings	2,000 lf	0.92	1.85	2.10
112	1½ in. galv. conduit and fittings	2,000 lf	0.71	1.50	1.70
113	1¼ in. galv. conduit and fittings	13,000 lf	0.574	1.25	1.70
114	1 in. galv. conduit and fittings	6,000 lf	0.45	1.10	1.65
115	¾ in. galv. conduit and fittings	13,000 lf	0.33	0.95	1.30
116	4 in. "Orangeburg" fiber conduit or equal with fiber endbells as required	300 lf	1.23	2.35	1.45
117	2 in. "Orangeburg" fiber conduit or equal with fiber endbells as required	6,000 lf	0.69	1.40	0.95
118	1 in. Everdur or equal conduit and fittings	400 lf	1.13	2.40	2.00
119	¾ in. Everdur or equal conduit and fittings	400 lf	0.88	1.85	1.60
120	Galv. C. I. boxes—volume greater than 150 cu. in.	1,500 lb	0.97	3.15	3.25
121	Cast brass or Everdur boxes, all sizes	600 lb	1.70	7.05	4.15
122	Electr. cabinets and special boxes, galv. sheet metal	500 lb	1.08	2.50	4.50
123	Roadway lighting fixtures	32 ea	112.79	170.00	225.00
125	Copper ground cable, bare	3,000 lb	0.81	1.10	1.50
	Sanitary Sewer System				
128	8 in. C. I. sewer pipe, in place	920 lf	8.15	4.65	11.50
	Piping and Drainage				
132	C. I. soil pipe for gallery drainage, in place	35,000 lb	0.26	0.40	0.50
134	Miscell. embedded fabr. steel pipe, in place	125,000 lb	0.409	0.38	0.50
135	Miscell. embedded std. black steel pipe, in place	8,000 lb	0.59	0.30	0.57
136	Miscell. embedded C. I. pipe, in place	200,000 lb	0.21	0.19	0.57
	Buildings and Service Rooms				
137	Control Building, complete	lump sum	77,022.00	82,000.00	120,000.00
139	Two stairway buildings, compl	lump sum	4,073.00	4 000.00	3,500.00
140	Stairway and elevated building compl.	lump sum	3,188.00	3,500.00	2,500.00
141	Fishlock operating bldg., compl	lump sum	1,916.00	1,500.00	2,200.00
142	Service rooms in non-overflow dam, complete	lump sum	9,100.00	7,500.00	12,000.00
	Miscellaneous Metal Doors				
143	Misc. metal doors and frames compl., in place	3,000 lb	0.32	0.80	0.85

Drainage Ditch on Mississippi River, Wisconsin

OWNER: Department of the Army, Corps of Engineers, St. Paul. Minn. H. M. Anderly, head engineer.

PROJECT: Construction of drainage ditch, in the vicinity of Cochrane, Wisconsin, comprising ditch excavation and orderly disposal of material, installation of culverts, placing protection stone, miscellaneous clearing, and other appurtenant work for intercepting seepage water from Pool No. 5 and for improving surface drainage of the area on the left bank of the Mississippi River throughout an overall distance of 4¾ miles. The work is divided into an upper reach about 12,900 feet in extent and a lower reach about 1,700 feet in extent, with an intervening stretch of about 10,500 feet where no work is required.

CONDITIONS: Contractor shall furnish all plant, materials, equipment, supplies, labor and transportation, including fuel, power, water. Stipulated contract time is 100 calendar days after notice to proceed. Access to job site is available by railroad and highway. Minimum wage rates are: power equipment operators, $1.90 per hour; mechanics, $1.65; truck drivers, $1.10-1.25; semiskilled laborers, $1.40; and unskilled laborers, $1.075.

LIST OF BIDDERS:

1. Loyd W. Mathis, Browning, Ill. — $23,216.00
2. Mark Eischeid Contracting Co., Inc., New Hampton, Iowa — 25,005.00
3. Frank Zimmer, Madison, Wisconsin — 25,182.20
4. L. G. Armold, Inc., Eau Claire, Wis. — 28,955.95
5. S. J. Groves & Sons Co., Minneapolis Minnesota — 34,390.00

			Government	Unit Prices	
	Item	Quantity	Estimate	(1)	(2)
1	Clearing	lump sum	$1,440.00	$499.00	$1,500.00
2	Excavation, ditch	51,300 cy	.50	.31	0.35
3	Culvert pipe, 36-inch	236 lf	12.65	14.00	12.50
4	Riprap	130 cy	10.32	20.00	10.00
5	Gravel backing	65 cy	3.18	8.00	10.00
6	Gravel for roadway surfacing	65 cy	4.67	6.00	10.00

Missouri River Levee, Kansas City, Mo.

OWNER: Corps of Engineers, Department of the Army, Kansas City District, Missouri; Col. Paul D. Berrigan, District Engineer.

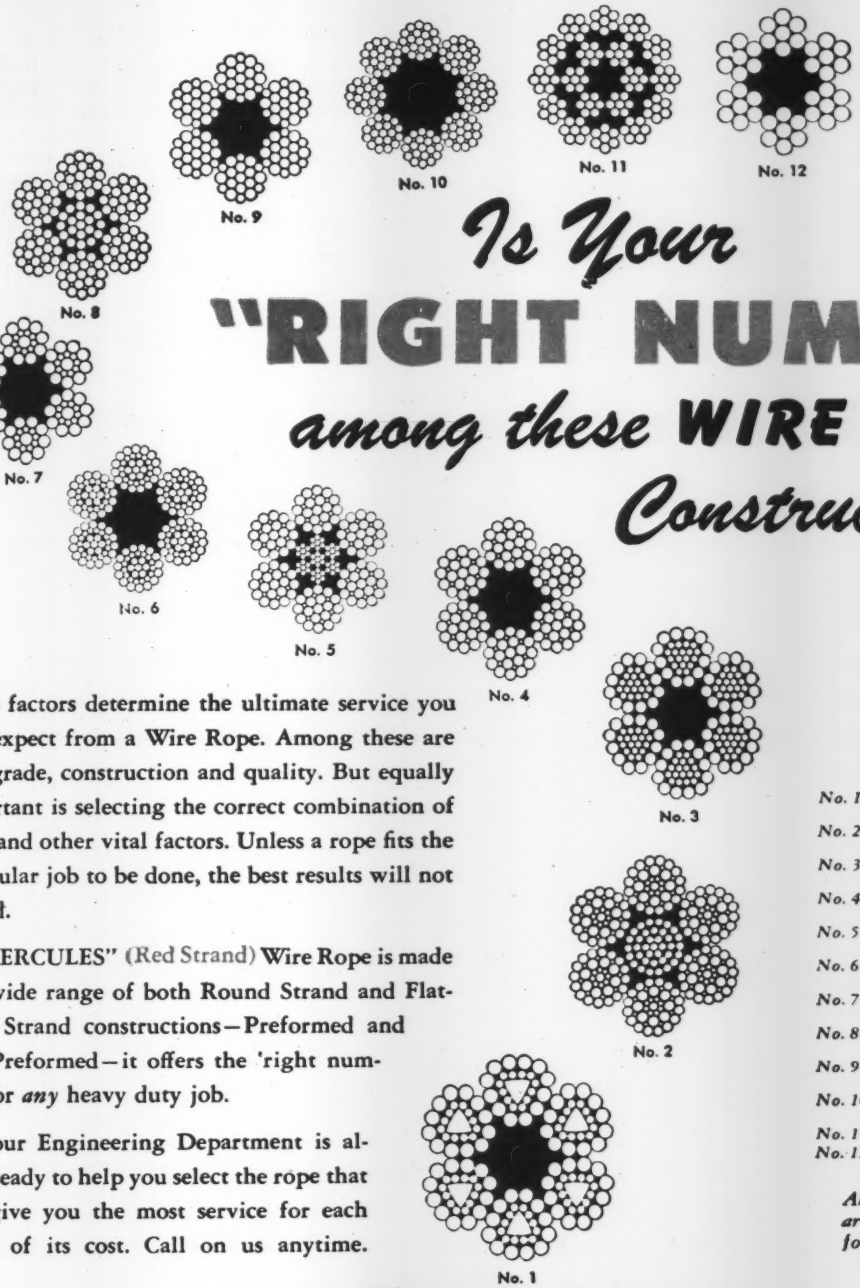
PROJECT: Construction of 7.9 miles of new levee along the left bank of the Missouri River in Buchanan County south of St. Joseph, Mo. Also raising 0.5 miles of existing levee to an average height of 13 feet; construction of 2.1 miles of new channel for Contrary Creek; clearing and enlarging 2.0 miles of the present channel of Contrary Creek. The levee will provide protection against floods to 9,100 acres of agricultural land.

CONDITIONS: All materials to be furnished by the contractor. Stipulated contract time is 375 days. Access to the job site is available by railroad, highway, and water. Prevailing hourly wage rates are: skilled, $1.40 to $1.75; semiskilled, $1.00; and common $.90.

LIST OF BIDDERS: *Contract awarded July 1, 1948

1. *George Bennett Constr. Co., Kansas City, Kansas — $435,166.75
2. Gould & Cross, Grand Rapids, Mich. — 557,297.00
3. T, Fisk Marbut, Emporia, Kansas, and Bales & Burnett Inc., Kansas City, Mo. — 575,021.00
4. O'Dell & Riney Constr. Co., Kirkwood, Mo. — 605,345.35
5. Perry McGlone Constr. Co., Kansas City, Mo. — 606,628.00
6. R. B. Potashnik, Cape Girardeau, Mo. — 626,121.00
7. List & Clark Constr. Co., Kansas City, Mo. — 634,821.00
8. Morrison-Knudsen Co., Inc., Boise, Idaho — 635,175.00

			Government estimate	Unit Prices (1)*	(2)
	Item	Quantity			
1	Clearing and grubbing	lump sum	$41,359.43	$30,000.00	$92,000.00
2	Common excavation	117,300 cy	.185	.245	.30
3	Earth fill	1,354,100 cy	.305	.265	.30
4	Rolling for additional compaction	800 rol hr	3.66	3.00	8.00
5	Water for embankment compaction	60 M gal	4.17	4.00	4.00
6	Filter blanket	475 cy	4.90	5.25	5.00
7	Dumped riprap	1,260 ton	4.14	4.25	5.00
8	Concrete	27 cy	48.69	65.00	60.00
9	Steel reinforcement	1,600 lb	.112	.15	.20
10	Structural excavation	500 cy	.99	2.00	1.00
11	Structural backfill	789 cy	1.06	2.00	1.00
12	Corrugated metal pipe—18 in.	184 lf	3.52	3.75	8.00
13	Corrugated metal pipe—36 in.	86 lf	9.00	8.00	20.00
14	Cut-off collars	6 ea	87.15	100.00	250.00
15	Flap gate—18 in.	2 ea	84.78	135.00	150.00
16	Flap gate—36 in.	1 ea	202.12	300.00	350.00



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No. 2—6 x 41 Round Strand—Metallic Core
No. 3—Style G Flattened Strand—Hemp Center
No. 4—6 x 19 Filler Wire Round Strand—Hemp Center
No. 5—6 x 19 Filler Wire Round Strand—Wire Rope Center
No. 6—6 x 37 Round Strand—Hemp Center
No. 7—6 x 19 Seale Round Strand—Hemp Center
No. 8—6 x 19 Round Strand—Metallic Core
No. 9—6 x 19 Warrington Round Strand—Hemp Center
No. 10—8 x 19 Filler Wire Round Strand—Hemp Center
No. 11—18 x 7 Non-Rotating
No. 12—6 x 7 Round Strand Haulage Rope—Hemp Center.

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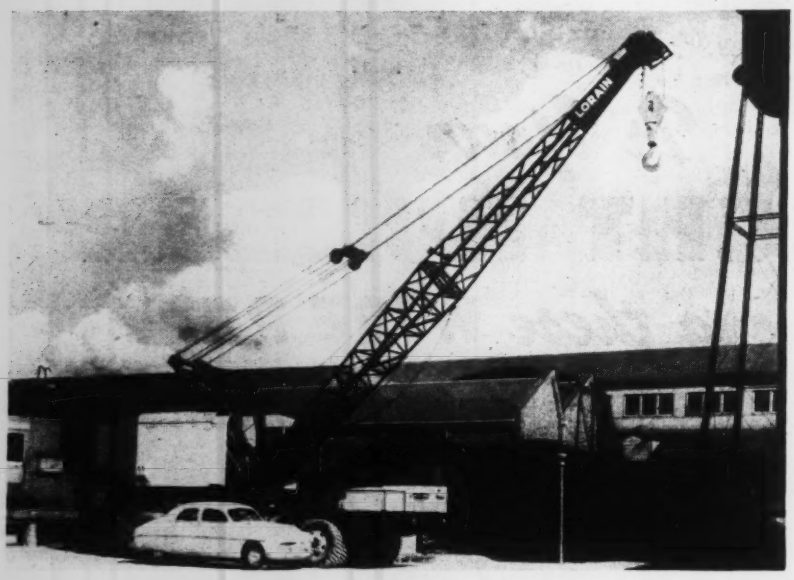
NEW PRODUCTS



GIANT CRANE—A giant, rubber-tired, 2-engined moto-crane is announced by Thew Shovel Co. It is said to be the largest of its kind ever made. The first unit was bought by Jones and Laughlin Steel Corp. for its Aliquippa Works. It has a safe-rated lifting capacity, on outriggers, of 45 tons at a 12-ft. radius. Weighing 65 tons, its length with boom in travel position over front of carrier is 66 ft. 5 in.; width, outside to outside of tires is 11 ft. 7¾ in.; height with gantry erected, 19 ft. 5 in., with gantry lowered, 14 ft. The MC-820 Moto Crane consists of the carrier and the turntable, or revolving superstructure. The welded steel frame is of multiple straight beam construction for side members which are solid steel 18 in. deep and more than 2 in. thick. Each side member consists of two such beams between outriggers, with the inner beam running the full length of the frame. Side members are joined together to front bumper and outrigger boxes serving as cross members and welded to the side members as integral construction. The crane is equipped with two Waukesha diesel engines. There are five carrier speeds forward. Rear axles are double reduction gear driven, and are among the largest made. At full load speed the turntable engine is rated at 164 hp. The boom is all-welded design with bolted butt splices. Main chord members are of high tensile alloy steel. Standard booms are 50 ft. long. For full description of this crane and others write to—*Thew Shovel Co., 1410 Terminal Tower, Cleveland 13, Ohio.*

DUMP BODIES—Built of 10-gage steel with channel steel members in the body sub-frame in capacities from 2 to 5 cu. yd. Six different hoists are offered to match various body lengths and capacities. The St. Paul model of body is 8 ft. long and of capacity 3-4 cu. yd.—*Gar Wood Industries, Inc., St. Paul Div., Minneapolis 14, Minn.*

SEWAGE PUMP — Adapted to the pumping of miscellaneous pulps, sewage, or trash, a non-clog pump has grease-lubricated bearings for protection. Shaft and bearings have been increased in size, and the rotor can be replaced without exposing bearings to dirt or changing their adjustment. Wear at the impeller inlet is taken up by an external adjustment.—*Economy Pumps, Inc., Hamilton, Ohio.*

CRUSHERS — Pioneer Engineering Works has issued information concerning two of its newer products—a giant size portable primary crusher and a triple roller crusher plant. The former —No. 153PR—has a 3042 overhead eccentric jaw crusher with 42 ft. x 14 in., 3 chain apron feeder, mounted on a 3-axle chassis equipped with 12–12.00 x 20 pneumatic tires. A 30 ft. x 25 in. built-in conveyor delivers the crushed material over the front end of the plant. The overall length of the plant is 40 ft., 6 in. Weight without "on plant" power unit is about 79,000 lb. Power required is 125 hp., continuous. The 4309 secondary crusher consists of a triple roll crusher with feed hopper and delivery conveyor mounted on a chassis equipped with eight pneumatic tires. The three rolls give a double pass of the material, thus greatly increasing the stage of reduction obtainable from a single unit. A feature is the positive gear drive using chromemolybdenum star gears which provide proper tooth contact for any adjustment of the rolls. The plant, without power unit, weighs about 40,000 lb.—*Pioneer Engineering Works, Inc., 1515 Central Ave., Minneapolis 13, Minn.*

CHISEL-TYPE ROCK BITS—With a blade mechanically seated in the body, chisel-type rock bits can be screwed on standard drill rods. Braze strains are eliminated by the new seating method, and water ports in both bevels give positive circulation. Bits come in sizes of 1⅜, 1½, 1⅝, 1¾, 2, and 2¼ in. with a shouldered contact between bit body and drill rod. Drilling speeds and life of bit are increased. No conversion of existing equipment is necessary in using the bit.—*Kennametal Inc., Latrobe, Pa.*

PAINT REMOVER—Extremely slow evaporation makes a new paint remover, Kelite Paint Lift, penetrate paint more thoroughly and get it off faster. The new product is safe on all metals, including aluminum, iron, tin, and magnesium. It contains no phenolic compounds, and it cannot blister skin. It is non-toxic, non-corrosive, and non-flammable.—*Kelite Products, Inc., Box 2917, Terminal Annex, Los Angeles, 54, Calif.*

FOOT RESTS for attachment to tractor, stationary engine or other platform on which operator must stand consists of thick, rubber mats which fasten with ¼-in. cap screws. Said to eliminate jar and fatigue from standing on hard surfaces. Specially designed safety tread of foot rest gives maximum traction and lessens accidents from slipping. Dimensions, 12 in. long, 6 in. wide, 1 in. thick—*Waterloo Foundry Co., Waterloo, Iowa.*

TRENCHER AND TRACTOR—Above is pictured the Everett trencher hooked up to a Ferguson tractor and in raised position. It can be quickly lowered into digging position—for any desired depth—by finger-tip hydraulic control of the tractor.—*W. W. Everett, 311 E. Broadway, Phoenix, Ariz.*

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THE 1/3 YARD SCHIELD BANTAM

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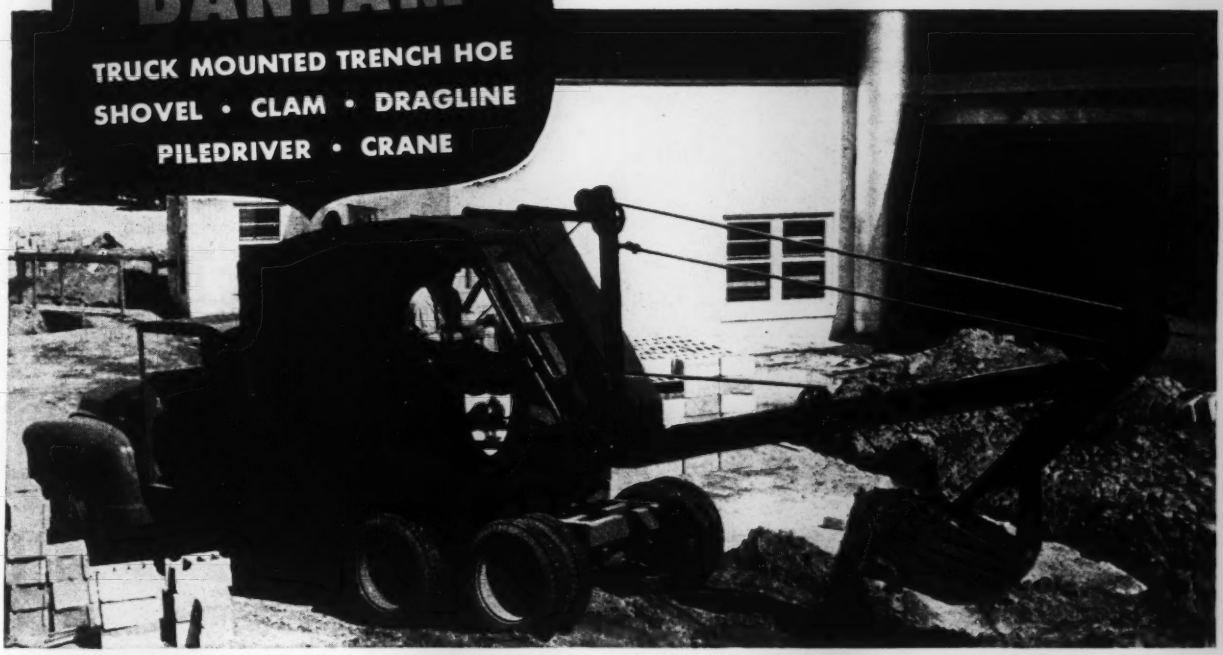

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Drive up and dig in. The Schield BANTAM goes into tight spots and gets the job done fast and economically. Its *full circle design* and smooth, *fast cycle operation* pile up profit-making yardage.

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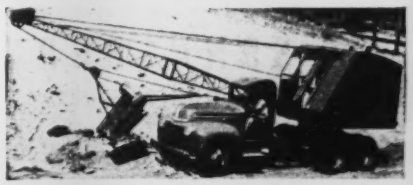

Dragline with box boom. The BANTAM is convertible in a matter of minutes.

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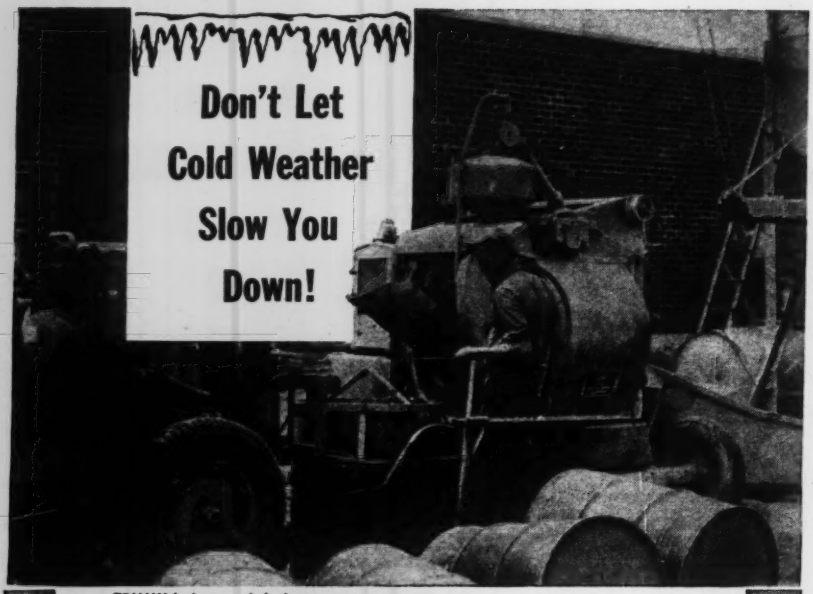

TRIMIX being used during construction of Dr. Salisbury's Laboratories, Charles City, Iowa.

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All winter long, TRIMIX helps keep concreting costs low, quality high, work on schedule. It aids mixing, pouring and placing of concrete at sub-freezing temperatures.

TRIMIX improves workability of mix, accelerates set, produces high early compressive strength and increases cement dispersion. Covering and heating time is reduced, forms are removed sooner.

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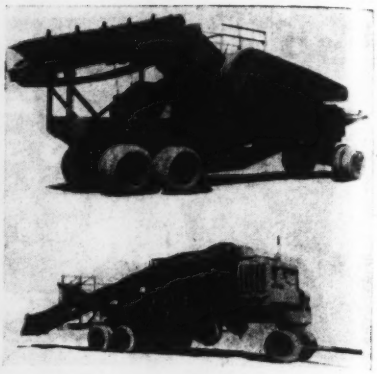

TWO-UNIT PORTABLE QUARRY PLANT—Mounted on pneumatic-tired chassis, a 2-unit portable quarry plant is designed for large production. Primary feeding and crushing is accomplished by the first unit, leaving the other for secondary crushing and screening. Split-feed arrangement to the screens of the secondary plant provides two complete screening surfaces for specification material.—*Pioneer Engineering Works, Inc., Minneapolis, Minn.*

RECORDING VIBROMETER — This machine measures and records frequency, displacement and wave shape of mechanical vibrations. Built to operate either when mounted on a fixed base or held in the hands. Weighs only 7 lb. and is less than 8 in. in length. Device has application in testing all types of reciprocating and rotating machinery within a vibration frequency range of 10 to 120 cycles per second. A prod extending from one side of the vibrometer is set in motion when held against a vibrating body. This motion is amplified by a cross-spring arrangement and transmitted to a stylus which inklessly records the vibration on wax paper.—*General Electric Co., Schenectady 5, N. Y.*

EXTREME PRESSURE DRY LUBRICANT—Molykote, a new-type dry lubricant consists of molybdenum disulfide powder and has the appearance of graphite, though it contains none. With

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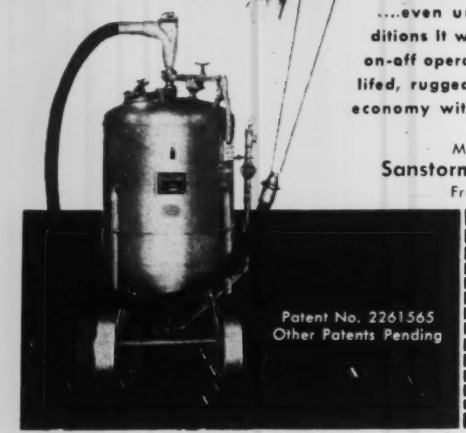

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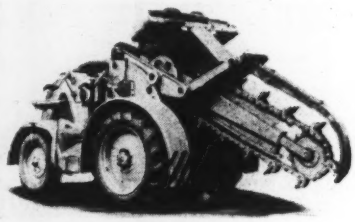
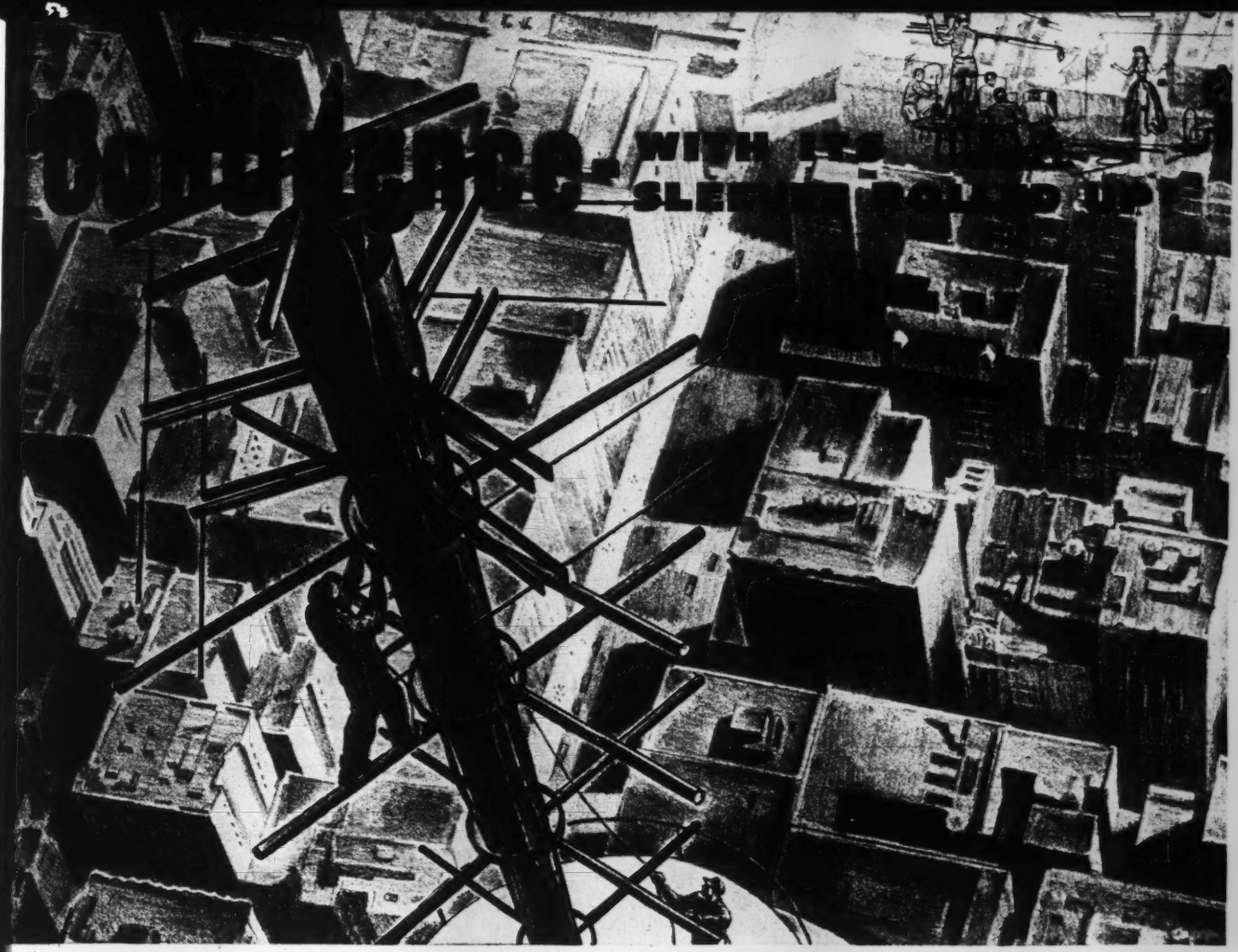
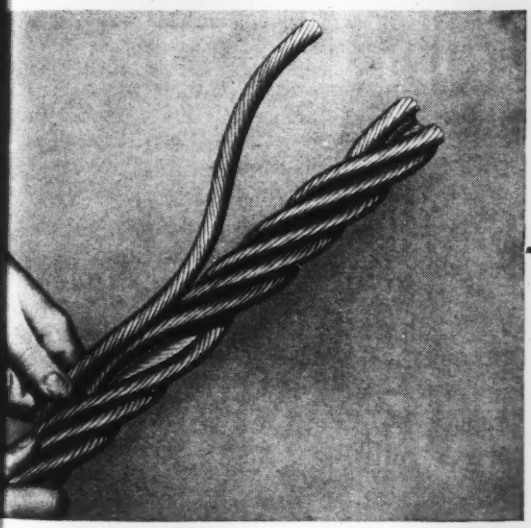
MOTOR GRADER—Tubular frame design absorbs and distributes shocks during operation of the BD 50-hp. motor grader. The "Roll-Away" moldboard cuts down friction, and blade maneuverability provides extensive range. Clearance from the cutting edge to the circle is 28-in. Six forward speeds from 1.3 mph. to 14.7 mph. and three reverse speeds from 1.5 mph. to 5.4 mph. are provided. Engine parts and other assembly units are interchangeable with the AD grader.—*Allis-Chalmers Mfg. Co., Tractor Division, Milwaukee, Wis.*



TRENCHMOBILE — A ladder-type trencher with a digging range of 5 to 7½ in. in width and up to 4 ft. in depth is now available. Rubber-tire mounted and self-propelled, the compact excavator has operating and trenching speeds for all purposes.—*Koehring Co., 3206 W. Concordia Ave., Milwaukee 10, Wis.*

DIESEL ENGINE—Adaptable to drilling, power generation, and many other tasks, the 6-LRD diesel engine is rated as a power unit at 281 hp at 900 rpm. Maximum output is 301 hp. at 1050 rpm. The engine is 8½x8½ bore and stroke, six cylinders, with a 2894-in. displacement. A seven-bearing 5½-in. graphitic steel crankshaft is heat-treated and hardened to give crank pin and main journal hardness of 75-90 scleroscopic index. Alloy cylinders test 400 Brinnell. Piston crowns are





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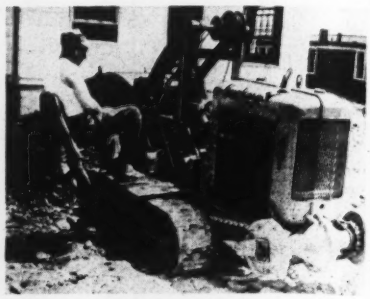
cooled by intermittent circulation of oil under pressure from the lubricating system. The engine as a power unit is equipped with waste packed oil filters, fuel filters, built-in governor, injection system and, if so desired, a mechanical gasoline engine starting system. Accessories of all types are available.—*Waukesha Motor Co., Waukesha, Wis.*



VEST POCKET DITCHER — New Buckeye 401 pony ditcher cuts narrow ditch 6 in. wide and 4 ft. deep. Digging buckets available also for 8-in. ditch. Unit weighs only 6,580 lb. and is powered by 47-hp. gasoline engine. Length of ditcher is only 13 ft. 9 in. and width is 4 ft. 4 in. Compactness of machine enables it to squeeze through areaways and to traverse lawns and walks without damaging them. Excavator boom is all-welded steel box type and is raised and lowered by self-locking worm hoist powered directly from engine transmission. Spoil is discharged at both sides of ditch. Left side crawler is adjustable vertically so that machine can maintain an "even keel" and dig a vertical ditch when operating along a slope or with one crawler on a curb. Recommended for small gas mains and service pipe and for burying cable.—*Gar Wood Industries, Inc. (Findlay Division), Findlay, Ohio.*

JACK SUPPORT—Designed to replace wooden wedge supports and have upright or inverted use, an aluminum alloy jack support, JS-1, weighs only 8¾ lbs. The jack is 15 in. high and has a 7x10-in. platform.—*Templeton, Kenly & Co., 1020 S. Central Ave., Chicago 44, Ill.*

ELEVATOR BUCKET—An independent "Ejector Plate" dislodges all contents of the elevator bucket. The plate serves as the back of the bucket but is attached to the elevator belt by an entirely separate mounting. Buckets come in standard sizes; special sizes by order. Construction is of $\frac{3}{16}$-in. steel plate, with or without reinforcement lip.—*Pekay Machine and Engineering Co., 100 N. LaSalle St., Chicago 2, Ill.*

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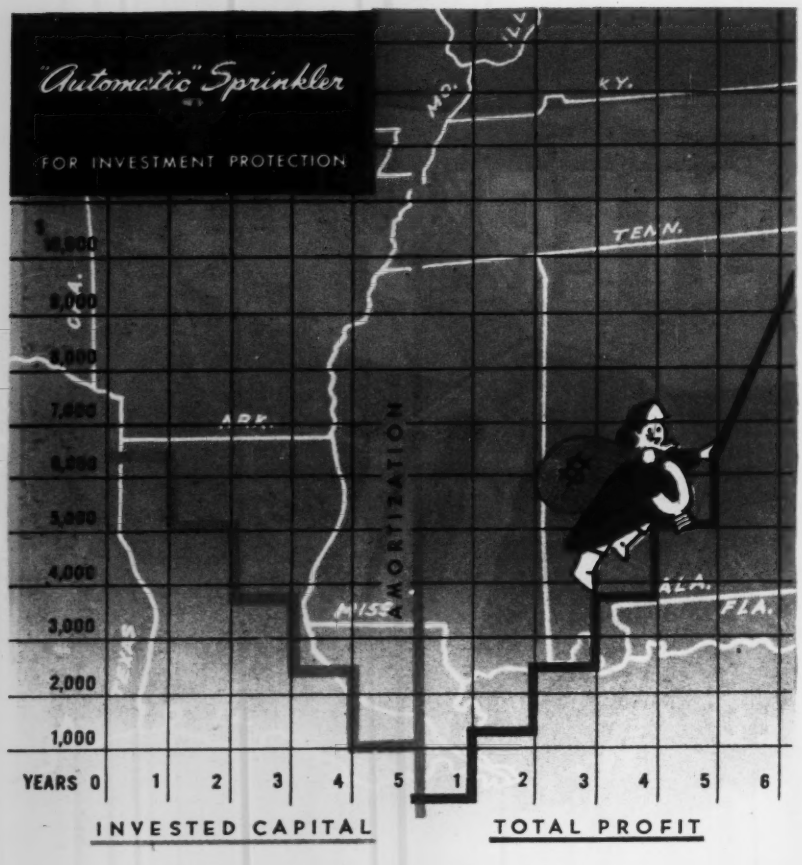

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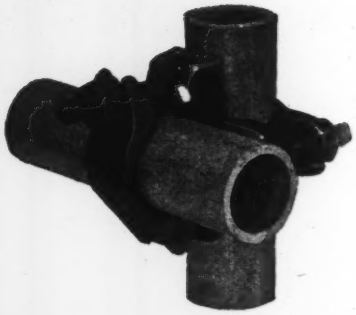
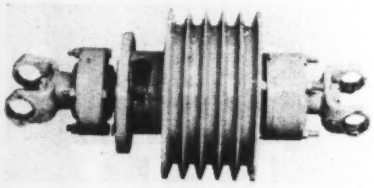


TUBULAR SCAFFOLD CLAMPS— Sturdie Drop Forged Clamps and Sturdie Connectors, to fit standard inch and a half pipe (about 2″ O. D.), facilitate the use by any contractor, of two inch tubular steel scaffold. Because the pipe-ends are not involved in most connections of horizontals and diagonals, stock pipe need not be cut to exact length. In most cases diagonals may be clamped at right angles to the horizontals in adjacent frames, thus reducing the number of swivel connectors needed. Male and female connectors for butting columns are needed only when the scaffold height exceeds the pipe length available.—*Leonard Malone Co., 342 Madison Ave., New York 17, N. Y.*



HEAVY DUTY POWER TAKE-OFF— Guaranteed to transmit full engine power to the driving of heavy duty truck-mounted equipment, the P-80 "packaged" power take-off is 16¼ in. long and weighs 125 lb. The unit is identical for all trucks and individual-truck mounting parts are kept in stock. —*Davey Compressor Co., Kent, Ohio.*

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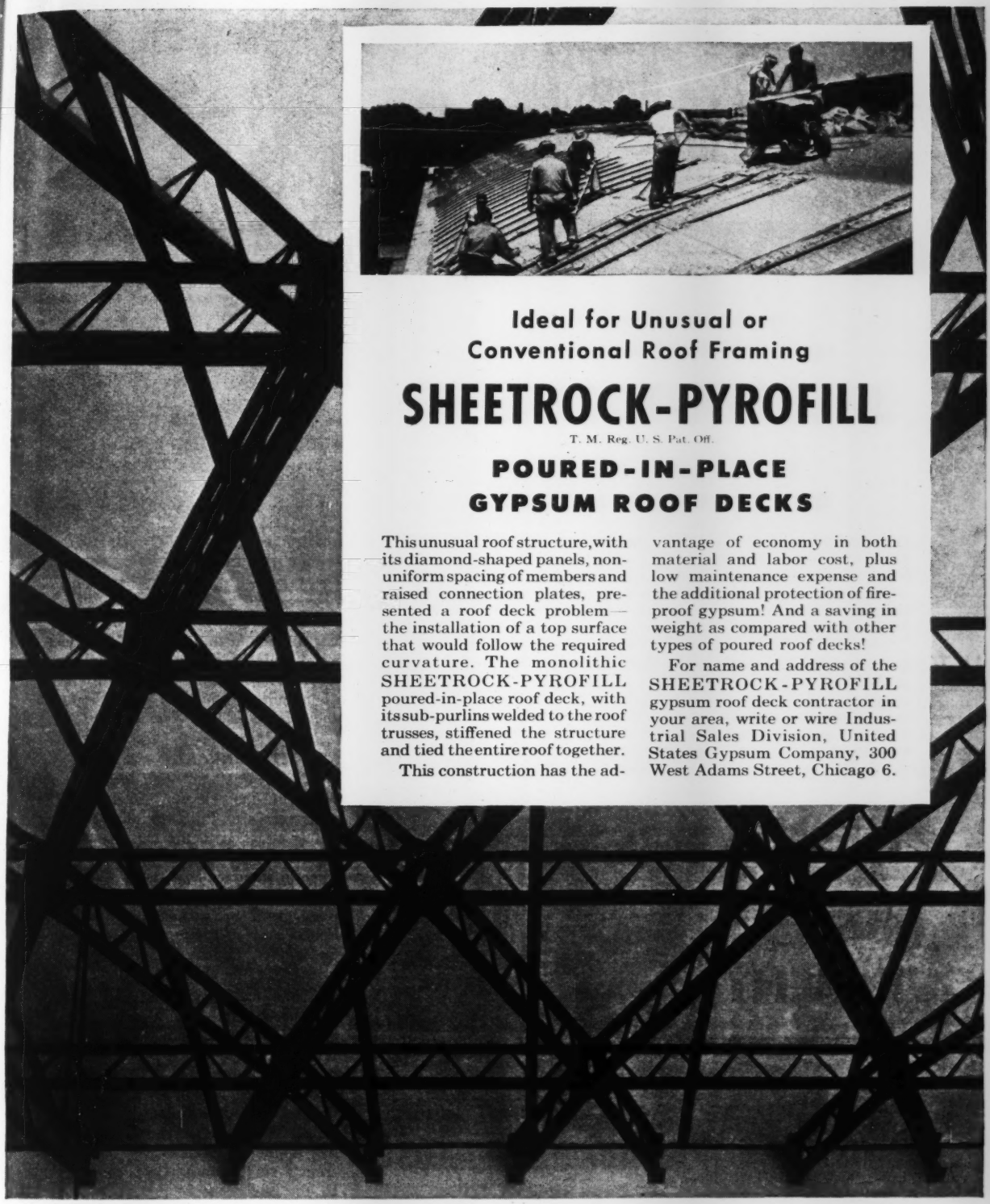

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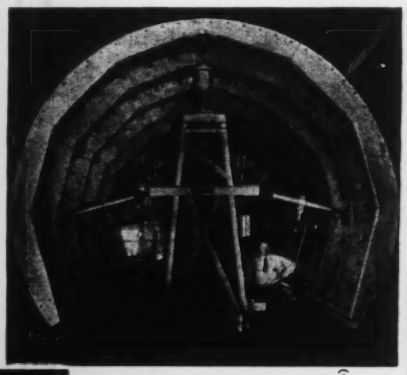

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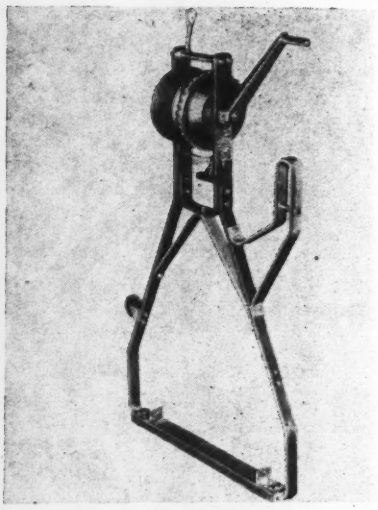
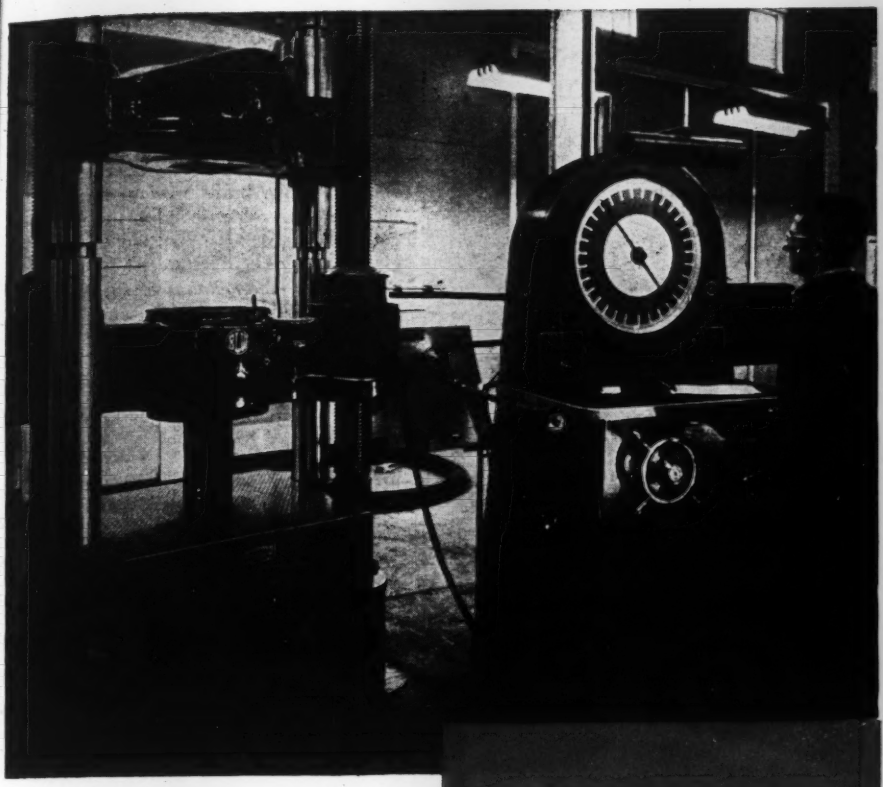


WINCH FOR SWINGING SCAFFOLDS—Faster, easier and safer operation of swinging scaffolds is claimed for a new aluminum "Saf-T-Swing" winch and stirrup unit. Simple 2-way crank operation permits raising or lowering the platform at a rate of 20 ft. per min. with minimum effort. The cable can be pulled from the drum by hand, reducing rigging time and allowing inspection of the cable. The units weigh only 55 lb, as the winch, drum, frame, crank handle and stirrup are all aluminum. — *Safway Steel Products, Inc., Milwaukee 13, Wis.*

ELEVATOR BUCKET—An independent "Ejector Plate" dislodges all contents of the elevator bucket. The plate serves as the back of the bucket but is attached to the elevator belt by an entirely separate mounting. Buckets come in standard sizes; special sizes by order. Construction is of ¼-in. steel plate, with or without reinforcement lip.—*Pekay Machine and Engineering Co., 100 N. LaSalle St., Chicago 2, Ill.*

RUNWAY LIGHT—Designed to exceed every requirement of CAA specification L-819 and Army Air Force Specification No. 32957, a new, type BHI, low-cost bidirectional, high-intensity runway light is announced. The new unit mounts on the same base as older units. The two main beams are formed by duplicate double-lens assemblies from a single lamp. Color is provided by the inner lens so that there are no hot colored lenses exposed to rain or snow. Controlled, uniform fill-in light across the runway and on the side away from the runway is provided from the same lamp by prismatic panels on the sides of the unit, which uses a 200-watt, 6.6 ampere aviation lamp No. 6.6, A/T 14P with medium prefocus base. Special low-loss transformers are available complying with CAA Specification L-806



ABOVE: Calibrating Testing Equipment at the Wharton Laboratory

ABOVE LEFT: Testing Concrete Cylinder for Compressive Strength

CONSTANT TESTING assures top quality

All materials used in the manufacture of Lock Joint Prestressed Concrete Cylinder Pipe are carefully tested to assure their uniformly high quality.

In Lock Joint's Laboratory at Wharton, New Jersey, accurately calibrated testing equipment checks the physical properties of all materials which constitute the finished product and test the physical characteristics of the completed pipe.

This constant check on all materials used in Lock Joint Pressure Pipe assures the top quality and long, useful service ot the finished product.

SCOPE OF SERVICES

Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.

LOCK JOINT PIPE COMPANY

P.O. Box 269, East Orange, N.J.

Pressure Pipe Plants:
Wharton, N. J. • Turner, Kan.

BRANCH OFFICES:

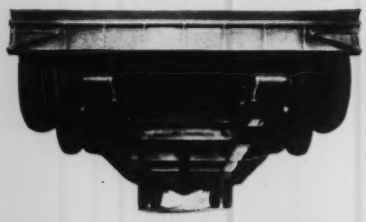
Cheyenne, Wyo. . . . . Denver, Colo.
Kansas City, Mo. . . . . Joplin, Mo.
Valley Park, Mo. . . . . Chicago, Ill.
Rock Island, Ill. . . . . Wichita, Kan.
Kenilworth, N. J. . . . Hartford, Conn.

are built with MORE than QUALITY MATERIALS

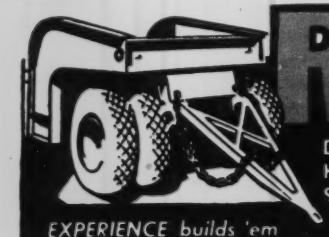
Pictured here is the Rogers Type D, eight rear wheel, two-way oscillating axle trailer. This trailer readily conforms to roadbed irregularities. Eliminates any tendency toward deck weaving or distortion.

Rogers time-tested and universally approved trailers for heavy and unusual hauling, are all products of exceptional engineering skill, acquired over a period of more than 32 years.

Progressive evolution has produced a complete line of trailers UNCOMMONLY STRONG but COMPARATIVELY LIGHT. They may be loaded easier and moved through traffic with greater speed and safety. They render exceptionally long periods of service with remarkable freedom from repair expense. AN IMPRESSIVE RECORD OF REPEAT ORDERS stands as convincing evidence of Rogers long and continued acceptance.



Shown above and at right are two views of the Rogers Walking Beam Trailer. Side swinging brackets permit operation with 8 or 10 ft. deck widths to conform to certain state requirements.



ROGERS BROS. CORP.

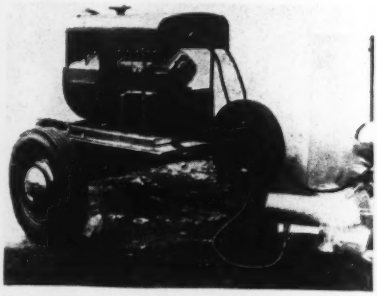
DESIGNERS and BUILDERS OF HEAVY DUTY TRAILERS SINCE 1915

EXPERIENCE builds 'em PERFORMANCE sells 'em

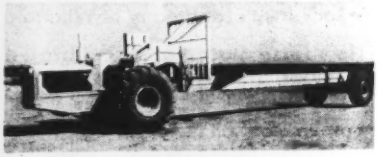
135 ORCHARD ST. ALBION, PENNA.

that can be installed in any Westinghouse type AN base or in any AN type deep base.—*Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.*

AIR-POWERED GENERATOR—Providing ample power to operate two 75-watt, 115-v. bulbs without the need for temporary electric lines, the Airlite generator cannot be harmed by short circuit or overload. Powered by an air compressor, the generator weighs 8¾ lb. Both 115 and 220-v. models are available.—*Ingersoll-Rand Co., Phillipsburg, N. J.*



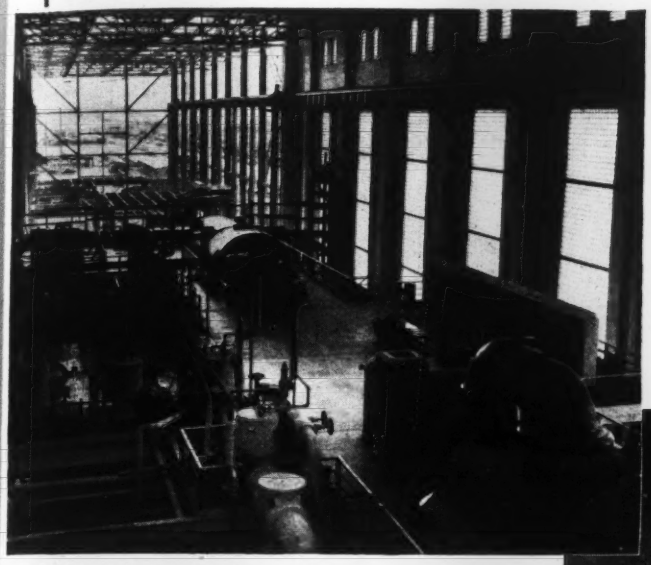
LIGHTWEIGHT WELDER — Engine-driven d.c. welder is powered by Wisconsin air-cooled engine, speed-ratio-coupled by a V-belt drive to a G.E. generator with 50 percent duty cycle. Unit weighs only 660 lb. for a maximum of 250 amp. of welding current. Fully calibrated dual control permits accurate setting of desired welding current before arc is struck. Welder has built-in auxiliary power outlet of 110 v. for operation of lights and power tools. Overall length is 44-⅛ in., width is 24½ in. and height is 35 ⅜ in. Stands on full length rigid welded steel base. For greater portability can be furnished mounted on a two wheeled pneumatic-tired trailer.—*General Electric Co., Schenectady 5, N. Y.*



MATERIAL HAULER—Tournahauler is a vehicle designed to haul long, heavy loads such as pipe, timber, steel, etc. Extra large low pressure tires afford flotation in soft, difficult ground conditions encountered in off-road hauling. Electric power steer permits full 90-deg. turn of Tournapull in relation to the rig.—*R. G. LeTourneau, Inc., Longview, Tex.*

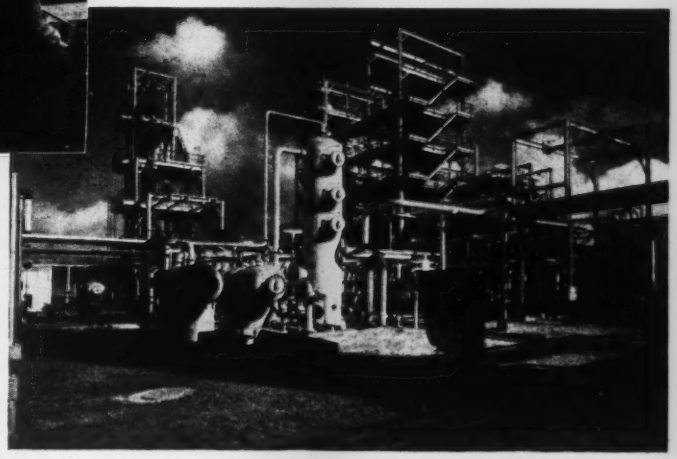
DOOR CLOSERS—A new line of aluminum surface door closers is being shown. Their light weight makes for Speedy and economical installation and reduces freight and handling costs. The closers

THE Common denominator



Interior view of First Section of new Redondo Steam Station of Southern California Edison Company, now under construction at Redondo Beach, California.

Crude Alcohol Unit of the Esso Standard Oil Company's Refinery at Baton Rouge, Louisiana.



Experience is the common denominator which is essential to the success of any project, large or small. The many years of experience of Stone & Webster Engineering Corporation in engineering, design and construction covers a wide range of diversified projects.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

BATES • GRATES

fit into every plant picture

If yours is an application like this—with pipes, installations and stairways cutting into the area— ***BATES • GRATES*** *will give you neat, safe and strong open steel flooring.*

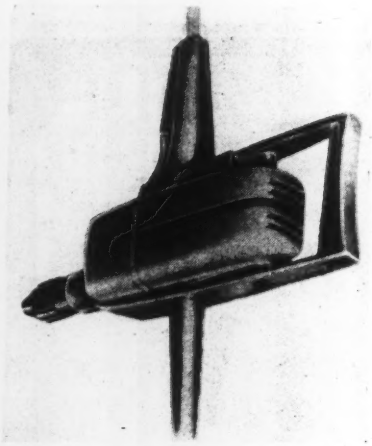
Here's where BATES • GRATES win universal approval — where a series of stairways combine with short walkways. Safe and strong, plenty of light and ventilation all the way down.

YOU can use BATES • GRATES for flooring any area or running any stairways. They serve to advantage in many ways: They are strong, safe, easy to maintain, durable, provide maximum lighting and ventilation.

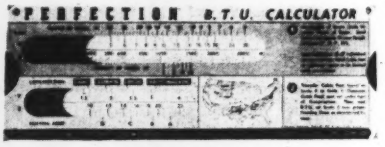
The simple directness of BATES • GRATES engineering accounts for these advantages. The key is the Hex Cross bar fillet-welded to stout main bars.

For open steel flooring and stair treads in your plant . . . *Get a Bid from BATES*

are of the rack and pinion hydraulic type and contain all steel interior parts. There is a special checking fluid—a non-gumming, not-freezing liquid which lubricates all the parts.—*Norton Door Closer Co., 2900–2918 N. Western Ave., Chicago, Ill.*



PORTABLE ELECTRIC DRILL — Lightweight construction and power are combined in the Model 500 ½-in. drill. Weighing 9 lb. drill includes a balanced armature, handles and housing of aluminum alloy, a.c.-d.c. motor, a blower-type fan and removable side handles for close-quarter drilling. Drill is supplied with a 3-wire, rubber-covered cable and attachment plug.—*Portable Electric Tools, Inc., 255-59 West 79th St., Chicago 20, Ill.*



B.T.U. SLIDE RULE—Pocket-size B.t.u. calculator slide rule permits quick and accurate determination of correct size of home heaters. The top scale determines the volume of the area to be heated, while the bottom scale determines the amount of B.t.u.'s required based on type of construction and geographical location of the building. Size and type of heater to give proper B.t.u. heat requirement are obtained from data on rear side of rule.—*Perfection Stove Co., Cleveland 4, Ohio.*

HOLE DIGGER—Manufactured in both automatic and manually operated models, "Speedigger" can be mounted on all tractors and jeeps. Standard model digs 8-in. hole up to 24 ft. deep for shallow tile wells. For setting utility poles, machine digs 12-in hole to 6½-ft. depth. Standard types are furnished with 12 in., or 8 in. dia. augers; other sizes also available.—*R. J. Piper Mfg. Co., Princeton, Ill.*

DIRT MOVERS TIME SAVERS MONEY SAVERS • • • •

Firestone

OFF-THE-HIGHWAY TIRES

ON ANY earth-moving or construction job, dependable, low-cost tire performance is essential to a profitable operation. *Downtime is a profit killer.*

Firestone Off-the-Highway Tires are money savers because they speed up work and cut downtime to the minimum. They can take hard punishment and stay on the job.

Hundreds of operating cost records show that Firestone Tires have accounted for very important savings in every type of off-the-highway work.

Whatever your operation may be, you can cut tire costs and downtime losses with Firestone Tires. If you will give them a trial, they will prove themselves.

Listen to the Voice of Firestone every Monday evening over NBC

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Firestone OFF-THE-HIGHWAY TIRES

Worthington-Ransome Blue Brute Distributors

See ad on page 135 for list of equipment in each line

Worthington-Ransome Distributors

Ala., Birmingham, Ragsdale Mach. Co., Inc.
Alaska, Anchorage, Airport Mach. & Storage Co.
Ariz., Phoenix, Lee Redman-Equipment Co.
Ark., Fort Smith, R. A. Young & Son
Little Rock, R. A. Young & Son

Calif., Richmond, Bay Equip. Co.
Calif., L. A. Golden State Equip. Co.
Colo., Denver, Power Equipment Co.
Conn., Wallingford, Wilhelm-Davies Co., Inc.

Fla., Miami, Allied Equip. Inc.
Jacksonville, Ogden Equip. Co.
Orlando, Highway Equipment and Supply Co.
Tampa, Epperson & Company

Ga., Atlanta, Tractor & Machinery Company

Ida., Boise, Olson Manufacturing Co.
Ill., Chicago, Thomas Hoist Co.
Iowa, Cedar Rapids, McNall Mach. & Supply Corp.

Kansas, Topeka, M. B. Salisbury Co.
Ky., Harlan, Croushorn Equip. & Supply Co.
Ky., Louisville, Williams Tractor Co.

Louisiana, Monroe, Louisiana Machy. Co., Inc.

Maine, South Portland, N. A. Burkitt, Inc.
Mich., Muskegon, Lakeshore Machy. & Supply Co.
Mich., Detroit, W. H. Anderson Co., Inc.
Minn., Minneapolis, Minneapolis Equip. Co.
Mass., Cambridge Field Machy. Co.
Mass., West Springfield, E. F. Edson Co., Inc.
Miss., Jackson, Jackson Road Equip. Co.
Md., Baltimore, Paving Supply & Equip. Co.
Md., Salisbury, Paving Supply & Equip. Co.
Mo., Clayton, The Howard Corporation
Mo., Kansas City, Machinery & Supplies Co., Inc.
Montana, Billings, Seitz Machinery Co., Inc.
Helena, Caird Eng. Works
Montana, Missoula, Miller Machinery Co.

Nevada, Elko, C. W. Paul Hardware and Machy. Co.
N. Hampshire, Manchester, R. C. Hazleton Co., Inc.
N. J., No. Bergen, American Air Comp. Corp.
N. M., Albuquerque, Industrial Supply Co.
N. M., Roswell, Smith Machy. Co.
N. Y., Buffalo, Murray Equip. Co.
New York, Hodge & Hammond, Inc.
N. Y., Syracuse, Mid-State Contr. Equip. Co., Inc.
N. Y., Troy, Capitol Equip. Co., Inc.
N. C., Statesville, Interstate Equip. Co.
N. D., Fargo, Smith, Inc.

Ohio, Cincinnati, Carroll-Edwards & Co.
Dayton, Carroll-Edwards & Co.
Toledo, The Kilcorse Machy. Co.
Okla., Oklahoma City, Tattan-Douglas Equip. Co.
Oregon, Portland, Andersen Machinery

Pa., Bradford, Bradford Supply Co.
Wilkes-Barre, Ensminger & Co.
Mechanicsburg, American Equip. Corp.
Philadelphia, Metalweld, Inc.

S. C., Columbia, Smith Equipment Co.

Tenn., Chattanooga, Dempster Bros., Inc.
Tenn., Knoxville, Dempster Bros., Inc.
Nashville, Dempster Bros., Inc.
Tex., Amarillo, T. W. Carpenter Equip. Co.
Abilene, W. T. McClure Mach. Co.
Dallas, Shaw Equip. Co.
Houston, So. Texas Equip. Co., Inc.
San Antonio, San Antonio Machy. & Supply Co.

Utah, Salt Lake City, J. K. Wheeler Mach. Co.

Vt., Barre, A. M. Flanders, Inc.
Va., Richmond, Highway Mach. and Supply Co.

W. Va., South Charleston, Allied Equip. Co.
Wash., D. C., Paving Supply & Equip. Co.
Wash., Seattle, Star Machy. Co.
Wash., Spokane, Star Machy. Co.
Wash., Yakima, Star Machy. Co.
Wisc., Milwaukee, Drott Tractor Co., Inc.

Ransome Distributors

O., Cleveland, H. B. Fuller Equip. Co.
Pa., Pittsburgh, Arrow Supply Company

Worthington Distributors

Ind., Indianapolis, Reid-Holcomb Company
Md., Baltimore, D. C. Elphinstone, Inc.
N. Y., N. Y., Air Compressor Rental & Sales.
O., Cleveland, Gibson-Stewart Co.
O., Columbus, Gibson-Stewart Co.
Pa., Pittsburgh, Atlas Equip. Co.
Texas, El Paso, Equip. Supply Co.
Wyoming, Cheyenne, Wilson Equip. & Supply Co.

Blue Brute Engines

Worthington Pump and Machinery Corp.
Worthington-Ransome Construction Equipment Division
Holyoke, Massachusetts

Manufacturers' Publications

Concrete Piles and Caissons—The several types of cast-in-place piles regularly driven by Western Foundation Corporation to meet the needs of differing foundation conditions are described in a new 12-page, four-color catalog. These types include:—Button-bottom piles, where a precast point is driven to good stratum and a corrugated shell of uniform size for its full depth is used as a shaft; pedestal pile, where concrete is driven out of a heavy driving tube to form an enlarged base; compressed pile, where concrete is forced out against the soil to form a large diameter shaft for the full depth; and caisson pile, with an uncased shaft up to 36-in. diameter. Also described are composite piles with wood or steel bottom sections and concrete tops, featuring a joint that will take both bending and tension—The booklet is very attractively illustrated with photographs and drawings to make clear the different uses of the piles described in the text.—*Western Foundation Corporation, 2 Park Avenue, New York 16, N. Y. and 308 W. Washington Street, Chicago 6, Ill.*

Flow Tubes—This 6-page folder explains the principle on which flow tubes operate. Curves plotted on cross-sectional and logarithmic charts illustrate the results of calibration tests. It is of interest and value to engineers desiring to improve the measurement or control of fluid flow through a pipe or conduit—*Bethlehem Foundry and Machine Co., Bethlehem, Pa.*

Earthmoving Film—"Euclids Move the Earth," a new full 16-mm. sound film covering Euclid's complete line of off-the-highway earthmoving equipment has been released. It is an on-the-job movie of the various applications of earthmoving equipment in metallic and non-metallic strip mines . . . highway and railroad projects . . . airports . . . dams . . . levees . . . and other large construction programs. Bottom Dump, Rear Dump, and Side Dump hauling units and the Euclid loader are shown on scores of jobs throughout the country dealing with the hauling problems and solutions peculiar to each type of job. This 30-minute presentation is now available. Requests to be made to Euclid representatives or distributors or directly to the Sales Development Department of the home office. This company has also just missed three new pieces of literature concerning off-the-highway earthmoving equipment—bottom-dump, rear-dump with 10-speed transmission and 16.00x24 drive tires.—*The Euclid Road Machinery Co., 1361 Chardon Road, Cleveland 17, Ohio.*

Timber Connectors—Substantial savings in hardware and lumber when split ring connectors are used instead of bolts is shown in a bulletin just out.—*Timber Engineering Co., 1319 Eighteenth St., N. W., Washington 6, D. C.*

Track-type Tractor—A 2-color, 32-page booklet presents the specifications of the "Caterpillar" diesel D6 track-type tractor, along with manufacturing and engineering features and views of typical jobs handled by this tractor.—*Caterpillar Tractor Co., Peoria 8, Ill.*

Concrete Floors—A 6-page illustrated folder tells how concrete and terrazzo floors may be insured against wear, deterioration and dusting by treating them economically with a patented liquid concrete hardener called "Lapidolith".—*Building Products Division, L. Sonneborn Sons, Inc., New York 16, New York.*

Digester and Scum Breaker—Design details and specifications are included in an 8-page bulletin concerning mechanism for scum breaking, sludge concentration and gas collection. Sewage treatment equipment is also listed, together with an interesting discussion of the chemistry of sludge digestion.—*Yeomans Brothers Co., 1445 Dayton Street, Chicago 22, Ill.*

Steel Service Plants—Illustrated booklets tell of Ryerson's larger steel-service plants at Cleveland, Ohio, and Emeryville, Calif. After giving the background of the company's operations the booklets continue with a picture story of the enlarged plants with their new cutting, handling and shipping facilities, and added space for warehousing large stocks of steel.—*Joseph T. Ryerson & Son, Inc., Box 6208, Cleveland 1, Ohio.*

Gear Testing—10-page folder describes the various models of the Parkson gear tester in sizes ranging from 4½ in. to 36 in. capacity. It contains valuable information for anyone who uses, makes, buys or specifies gears.—*George Scherr Co., 200 Lafayette St., New York 12, N. Y.*

Asphalt Roofing—A 35-cent, 84-page manual on the manufacture, selection

"We've Standardized On Blue Brutes"

Millard Buzby Epley, Treasurer of Buzby Brothers, Westville, N. J.

Buzby Brothers' profit-boosting fleet of Ransome Blue Brute Hi-Up Truck Mixers at their batching plant in Westville, N.J. The three 3-yd. Mixers at left, bought in 1946, proved so satisfactory that the other five Hi-Ups were added—two in 1947, and three in 1948.

Here's how Ransome Blue Brute Hi-Up Truck Mixers rate with men who use them constantly. Millard Epley, Treasurer of Buzby Brothers, writes:

"All our Hi-Ups have had an absolute minimum of down time. Non-availability has never cost us a penny.

"Every Mixer must be on call for any size and type of job, at any hour. Ransome's quick charging action at the plant, thorough mixing en route and fast discharging at the job allow us to average nearly 200 yds. a day on six-or seven-mile hauls.

"I believe Ransome's better mixing action makes stronger concrete — I know all our customers are satisfied.

"Due to Ransome's A-1 service and the excellent operation of our Hi-Up Mixers, we have found it profitable to standardize entirely on Blue Brutes."

Get around among Hi-Up users and you'll find this is a familiar story, with smooth-running, efficient Blue Brute Truck Mixers saving time and money on every job. Write for Bulletin 221, or see your nearby Worthington-Ransome Distributor (listed on page 134) for full proof that *there's more worth in Worthington.* R8-3

WORTHINGTON

WORTHINGTON PUMP AND MACHINERY CORPORATION
Worthington-Ransome Construction Equipment Division, Holyoke, Mass.
Distributors in all principal cities

Fast action! One of Buzby Brothers' 3-yd. Hi-Ups, pouring concrete flooring for a new warehouse at Gibbsboro, N.J. This job, 10 miles from the batching plant and totalling 51,000 sq. ft. was completed in 13 days.

Buy Blue Brutes

IF IT'S A CONSTRUCTION JOB, IT'S A BLUE BRUTE JOB

SINK 'EM AND FORGET 'EM!
THEY'RE KOPPERS PRESSURE-CREOSOTED FOUNDATION PILES
That's the beauty of installing Koppers Pressure-Creosoted Piles—they are in to stay. The permeation of creosote protects these piles against decay, termites and acid or alkaline soils. And the wood retains the creosote year after year. Here's proof: some pressure-creosoted piles were pulled after being in use for nearly fifty years; they were still "loaded with creosote."
Koppers Pressure-Creosoted Piles are quickly available . . . are ready to be driven when received . . . are usually lower in cost than other permanent pile materials. Specify Koppers and you'll get economical and permanent piling.
KOPPERS COMPANY, INC.
Pittsburgh 19, Pa.
KOPPERS
PRESSURE-TREATED WOOD
Modern building codes for permanent structures accept foundation piles of pressure-creosoted wood, provided the cut-offs are soaked in creosote and capped in concrete.

and application of asphalt roofing products is available from member companies of—*The Asphalt Roofing Industry Bureau, 24 W. 54th St., New York ity.*

Diesel Tractor—A 32-page booklet describes the features of the Caterpillar Diesel D4 tractor. It contains engineer's drawings, cutaway sectional drawings and photographs of the working parts and pictures of the tractor at work. The company has also just released a booklet on "Turning Blueprints into Highways," and another on "Caterpillar Diesels go to Town."—*Caterpillar Tractor Co., Peoria 8, Ill.*

Scaffolding and Ladders—A bulletin tells about scaffolding and ladders which the manufacturer calls safe equipment for faster and better work at any height. Basic parts are standard couplers, bases and tubes. Also described are safety scaffolding machines, swinging scaffolds, sidewalk bridges and ladders.—*The Patent Scaffolding Co., Inc., 3821 Twelfth St., Long Island City 1, N. Y.*

Motor Grader Film—A new, 16 mm. full-color, sound moving picture, "Adams All-Purpose Motor Graders," has recently been completed. The movie shows motor graders at work on a wide variety of road construction, maintenance, and miscellaneous grading jobs. It also shows the new rotary snow plow at work on a motor grader as well as "V"-type plow and wing snow removal work. The film can be seen by contacting any Adams distributor.—*J. D. Adams Mfg. Co., Indianapolis, Ind.*

Coolant Circulating Pumps—An 8-page bulletin tells all about Allis-Chalmers foot mounted, submerged and side-wall mounted coolant circulating pumps. The construction details and application information are supplied for each of the eight types, together with dimensions, head capacity, motor frame, pipe friction and valve and fitting flow resistance tables.—*Allis-Chalmers Mfg. Co., 1018 S. 70th St., Milwaukee, Wis.*

Avoiding Truck Accidents—A new industrial data sheet on the safe use of trucks has been prepared. It covers the particular phases of truck operation that create the major accident problems and outlines safe procedures to reduce hazards. It warns drivers, repairmen and workers about the dangers in unexpected movements of trucks, in the loading and unloading of materials, and in getting on and off vehicles—*National Safety Council, 20 N. Wacker Drive, Chicago 6, Ill.*

Painted for U. S. Pipe & Foundry Co. by Paul Laune

U.S. cast iron PIPE

FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE

Improvements in the quality, and quality-controls, of U. S. Cast Iron Pipe are the fruits of research and development. They are also the rewards of patience.

Months of pilot plant operation may elapse before a process-development is adopted as standard manufacturing procedure. Exhaustive tests in our headquarters research laboratory, one of the finest foundry laboratories, must precede a "go-ahead" to our plants. This is just another reason why you can lay U. S. Cast Iron Pipe with confidence. **United States Pipe and Foundry Co., General Offices: Burlington, New Jersey, Plants and Sales Offices Throughout U.S.A.**

with Condor Whipcord V-Belts

A team of 12 Condor Whipcord V-Belts lasted 4 times longer than previous V-belt constructions on the dredge shown above. They operate from a 500 HP Diesel Engine to an 85 kw, d-c. generator which in turn operates a 75 HP motor. The principal reason for the outstanding record is Manhattan's method of manufacture. The stout, endless-wound Whipcord Strength Member engineered by Manhattan is pre-stretched.

This reduces on-the-job stretch to a minimum, so that all Condor V-Belts pull together as *one*. Heat-dissipating Flexlastics cushion the shock of heavy engine acceleration and maintain firm, wear-resistant contact in the sheave grooves. The Flexlastics cover is weather-resistant. Oil-Proof and Non-Spark constructions are available on specification.

Try Condor Whipcord V-Belts on your next installation and save on the longer service they give.

("Flexlastics" is exclusive with Manhattan)

RAYBESTOS-MANHATTAN INC.

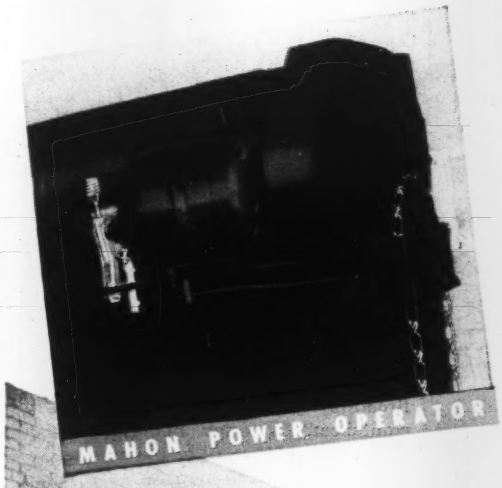
Keep Ahead with Manhattan

MANHATTAN RUBBER DIVISION PASSAIC, NEW JERSEY

Manufacturers' Activities

Sales—Charles F. Martin, Jr., has joined the sales and engineering staff of the TIMBER ENGINEERING CO. as manager of the Chicago office . . . V. L. Snow is assistant sales manager of THE EUCLID ROAD MACHINERY CO. . . . Paul E. Miller has been appointed to the board of regional sales supervisors of the EUTECTIC WELDING ALLOYS CORP., 40 Worth St., New York, 13, N. Y., and Jack R. Koske is regional sales supervisor in east central U. S. . . . W. Troy Gaunt is district sales manager at St. Louis, Mo., for UNIVERSAL ATLAS CEMENT CO. Winfield H. McDowell, for 14 years sales manager of the Kansas City territory, has retired after 37 years with the company. Harold J. Layden is manager of the Kansas City sales area . . . L. T. Martensen, Jr., has joined LINDBERG ENGINEERING CO., Milwaukee, Wis., as a sales engineer . . . Kenneth Williamson is district sales manager of the OSGOOD CO. and the GENERAL EXCAVATOR CO., Marion, Ohio, for Arizona, Colorado, New Mexico, Utah, Wyoming and parts of Idaho, Montana and Nebraska . . . Joseph N. Banky is a sales representative of the Chicago district office of ALLIS-CHALMERS . . . Robt. B. Barnes is sales manager of the LINK-BELT SPEEDER CORP. . . . REYNOLDS METALS CO., Louisville, Ky., is planning to decentralize sales operations of its building products division. There will be four sections geographically. H. N. Kirchdorfer is eastern sales manager of the parts division, New York. Harry H. Armstrong is at the Chicago office to specialize in sales of Alumi-Drome in the Midwest . . . A. J. Eldridge is sales manager in the U. S. for CONSTRUCTION IMPROVEMENTS, LTD., of Toronto, Ont., at 209 S. High St., Columbus 15, Ohio. The firm is associated with LIDGERWOOD INDUSTRIES, INC., of New York in the manufacture and sale of LIDGERWOOD TRAVELIFT CABLEWAYS . . . Gordon A. Weller is assistant manager of replacement sales and Frank A. Calosimo, chief service engineer of the AMERICAN BRAKELOK division of the AMERICAN BRAKE SHOE CO. . . . W. Rex Becker has been appointed sales manager of standard lines for the GENERAL ELECTRIC CO's conduit products division . . . John A. Storrs is a N. Y. district sales representative for KENNAMETAL, INC., Latrobe, Pa. . . . Richard E. Hoagland is manager of by-products sales for KAISER CO., INC., at 756 So. Spring St., Los Angeles 14, Calif. . . . Gordon V. Millichamp is

Rolling Steel DOORS



Manually • Mechanically • Power Operated

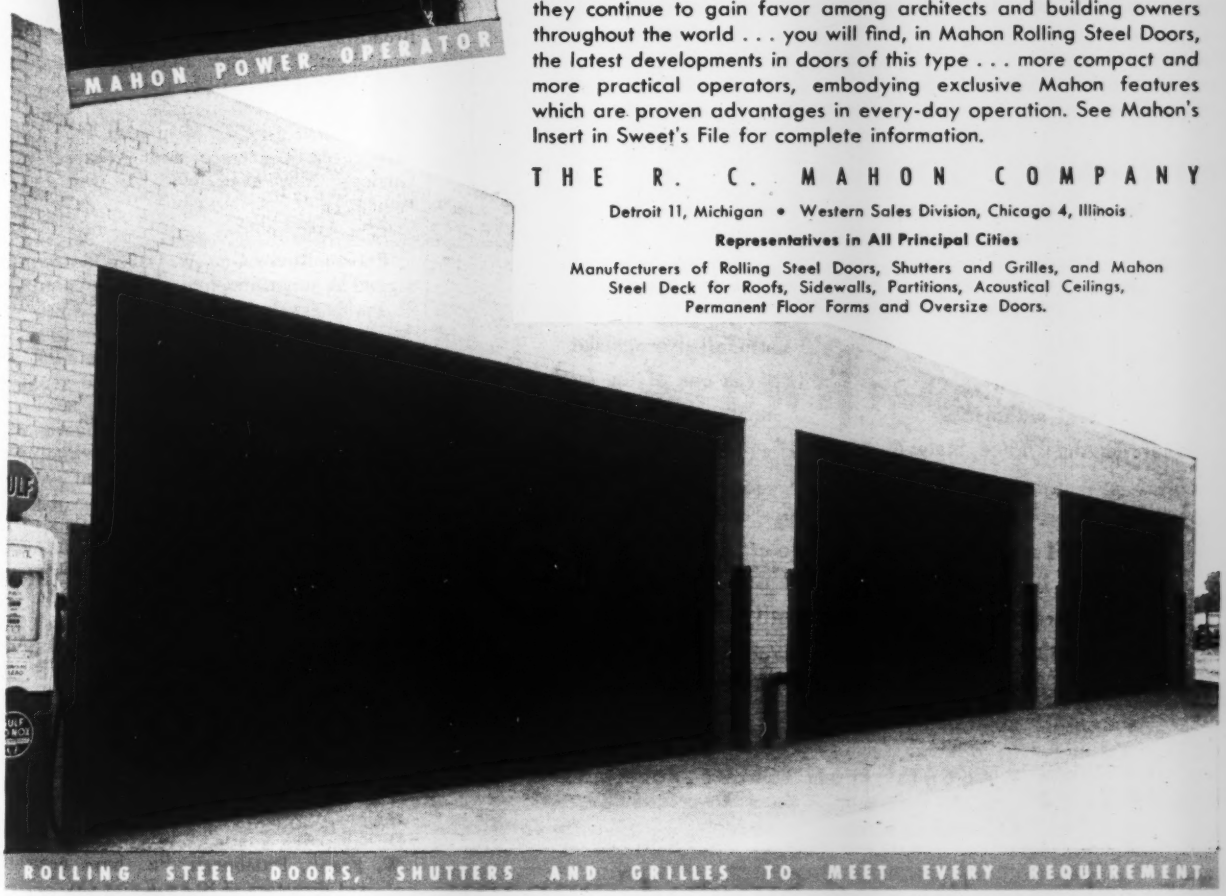
No other door offers the manifold advantages of the Rolling Steel Door . . . their vertical action requires less space—both inside and outside of the building. Being constructed entirely of steel, they require virtually no maintenance, and they provide more positive protection throughout a lifetime of trouble-free service. Every architect wants to provide doors which embody all of these advantages in their most modern form. A study of Mahon Rolling Steel Doors—details of their construction and materials used—will reveal why they continue to gain favor among architects and building owners throughout the world . . . you will find, in Mahon Rolling Steel Doors, the latest developments in doors of this type . . . more compact and more practical operators, embodying exclusive Mahon features which are proven advantages in every-day operation. See Mahon's Insert in Sweet's File for complete information.

THE R. C. MAHON COMPANY

Detroit 11, Michigan • Western Sales Division, Chicago 4, Illinois

Representatives in All Principal Cities

Manufacturers of Rolling Steel Doors, Shutters and Grilles, and Mahon Steel Deck for Roofs, Sidewalls, Partitions, Acoustical Ceilings, Permanent Floor Forms and Oversize Doors.



ROLLING STEEL DOORS, SHUTTERS AND GRILLES TO MEET EVERY REQUIREMENT

Three Mahon Power Operated Rolling Steel Doors, 26' x 12'-6", Recently Installed in the New Plant of Peninsular Metal Products Corp., Detroit, Michigan.

MAHON

How do you rate your surety?

If you are pressed for time on a job and you need immediate bond service, has your Surety the organization — the nationwide facilities — necessary to render that service promptly and efficiently?

If the job is an unusual one, requiring special consideration, has your Surety the right combination of experience and technical "know-how" to handle your bond?

Is your Surety readily acceptable by *all* private, municipal, state, county, and federal authorities *anywhere* in the United States?

Is your Surety nationally recognized as one of the *leaders* in the business?

To be *sure* of an affirmative answer to *all* these questions; to be *sure* of the best available Contract Bond Service — see the Ætna Representative in your community. He will place at your disposal the knowledge, the experience, the resources, and the reputation of one of the nation's great Surety organizations.

Agents from coast to coast

Ætna Casualty and Surety Company

Affiliated with Ætna Life Insurance Company

Automobile Insurance Company • Standard Fire Insurance Company

HARTFORD 15, CONNECTICUT

manager of the PENNSYLVANIA RUBBER Co's N. Y. sales branch . . . Gerald W. Wilson and Wm. F. Jordan are Eastern sales division district representatives of CATERPILLAR TRACTOR Co., Peoria, Ill. . . . M. J. Boho is vice-president in charge of sales of HAGAN CORP., Pittsburgh . . . O. W. Schmidt is Central states district sales manager for ATLAS CHAIN & MFG. Co., Philadelphia . . . J. P. Johnson, Jr., is Philadelphia sales representative at 123 So Broad St. for the AMERICAN LUMBER and TREATING Co. and W. E. Wilkins is Baltimore, Md. representative.

Distributors—ROZIER-RYAN Co., 3340 Morganford Rd., St. Louis, Mo., is regional warehouse representative for the R. P. B. CORP., Oakland, Calif., makers of the Mighty Midget pavement breaker . . . UNION ROOFING & PAPER Co., INC., York, Pa., is a distributor for the RICHKRAFT Co. of Chicago . . . In the New York metropolitan area, sale of W. & L. E. GURLEY instruments will be handled by L. L. RIDGWAY Co., 324 Lafayette St., who will open a branch office at 277 Broadway for the display of GURLEY equipment. WESTERN BLUEPRINT Co., Kansas City, Mo., will be the new agent for Kansas and Western Missouri, and Wray Williams Co., Memphis, Tenn., will cover Tennessee and Arkansas. Gurley's New York office is discontinued.

Personalities—Geo. W. Oakes has resigned as superintendent of PITTSBURGH PLATE GLASS Co.'s plant at Crystal City, Mo., to manage his personal business interests. Robt. M. Conley, Carnegie Institute of Technology, 1917, is the new superintendent. Paul Brainard is head of the new Hyster engineering standards department of the HYSTER Co., Portland, Ore. . . . C. H. Lage is vice-president and general works manager of the LA PLANT-CHOATE MFG. Co., INC., Cedar Rapids, Iowa . . . James A. Nary is vice-president in charge of production of the U. S. TESTING Co., INC., Hoboken, N. J. A. C. Anderson, Omaha, Neb., has been appointed regional director for the ASSOCIATED EQUIPMENT DISTRIBUTORS in Iowa, Kansas, Missouri and Nebraska . . . C. W. Staacke, belt conveyor engineer, has joined HEWITT-ROBINS, INC., as a technical consultant . . . B. F. Bilsland is manager of the new Midwest region of ALLIS-CHALMERS . . . David D. Kennedy, Nunda, N. Y., and Robert W. Frank, Pittsburgh, Pa., have been elected directors of BLAW-KNOX Co. . . . Ralph M. Hoffman has been elected a vice-president of LINK-BELT Co. . . . C. E. Tweedle is vice-president of ARKANIA REGULATOR Co., Chicago, Ill. . . . L. S. Meyer has been chosen president of the HYDRAULIC PRESS BRICK Co.,

ROUGH IDEA FOR A SMOOTH SURFACE

Another Top Performance by a BWH Product

When new concrete is applied to an old surface, tedious groundwork is involved. In this case, the mammoth face of a dam had to be roughed with compressed air into an irregular pattern that would hold the refacing material.

The air hose used on the job couldn't be any "sissy"! It had to take high pressures and high temperatures. It had to withstand oil, the crash of falling rocks, the shock of being yanked over jagged edges of broken concrete. After a careful survey, the contractor chose BWH Bay State Air Drill Hose for the job, and its outstanding performance more than justified his judgement.

Constructed with an extra-heavy rubber tube, this rugged hose has a carcass of multi-ply closely woven duck bonded with long-life friction. Tube and carcass are enclosed in a husky rubber cover that resists abrasion and weathering. This powerfully built hose performed perfectly, and helped the contractor finish the job economically, efficiently and right on schedule.

BWH Bay State Air Drill Hose is just one of the many famous rubber products made by BWH. Whatever industrial rubber goods you need, look to BWH products for dependable ruggedness and to BWH distributors for dependable service.

HAVE YOU A JOB WHERE STAMINA COUNTS?

Bring us your toughest problems — we're specialists in solving them. Consult your nearest BWH distributor, or write us direct.

Another Quality Product of

BOSTON WOVEN HOSE & RUBBER COMPANY

Distributors in All Principal Cities

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succeeding Geo. A. Bass, new board chairman . . . D. J. Erikson has been elected president of HAGAN CORP. and its subsidiary companies. He started with the company as a draftsman more than 30 years ago . . . Marshall G. Munce has been elected a vice-president of YORK CORP., York, Pa.

Deceased—Mathew R. Rosse, 50, export manager of the COLORADO FUEL and IRON CORP., New York, died Oct. 7 . . . Herman Larsen, experimental engineer for the FOUR WHEEL DRIVE AUTO Co. for the last 28 years, died at Colorado Springs, Colo., Sept. 15 . . . Carroll D. Hepler, 43, general manager of the GENERAL ELECTRIC Co.'s construction materials department, Bridgeport, Conn., died at New Kensington, Pa., Sept. 22 . . . Arthur H Wyman, 65, manager of ALLIS-CHALMERS general machinery sales office at Cleveland, died Oct 5.

Miscellany—BYRNE DOORS, INC. has removed its offices and plant to new buildings—main office, 1421 East 8 Mile Rd., Ferndale, Detroit 20, Mich., and plant, 1501 Bonner Ave., Ferndale, Detroit 20, Mich. . . . The new eastern convector-radiator factory of the TRANE Co., La Crosse, Wis., is now in mass production at Scranton, Pa. . . . Lapel service pins have been awarded to 21 long-time employees at 15 UNIVERSAL CONCRETE PIPE Co. plants . . . NEPTUNE METER Co. has acquired a controlling stock interest in the RENSSELAER VALVE Co., Troy, N. Y. . . . THE MERRILL Co., engineering, San Francisco, Calif., is to incorporate a subsidiary company, THE MERRILL-BROSE Co. to carry on an agency department of eastern manufacturers, including YEOMAN'S BROTHERS Co. of Chicago. Geo. Brose, vice-president will be general manager of the new subsidiary which will look for distributorships . . . On Oct. 7 about 160 participants in the Georgia Better Farms tour were entertained by the GARY WORKS and the GARY SHEET and TIN MILL of CARNEGIE-ILLINOIS STEEL CORP. at Gary, Ind. . . . The second extension of plant facilities within a year—to cost $200,000 is now under way at KENNAMETAL, INC., Latrobe, Pa. . . . The second materials handling conference sponsored by WESTINGHOUSE ELECTRIC CORP. will be held at Buffalo, N. Y., Nov. 8-9 . . . MARQUETTE CEMENT MFG. Co., has received three certificates of achievement in safety from the U. S. Department of the Interior, Bureau of Mines, in recognition of its outstanding record of safety in operations at Marquette quarries in Oglesby, Ill., Cape Girardeau, Mo., and Earlham, Ia. . . . SKF INDUSTRIES, INC., ball and roller bearings, marked the first year of operations of its plant at Hornell, N. Y., with a

Advantages of Fluid Drive

- . . . smoother flow of power
- . . . protection against overloading and stalling
- . . . full torque at all speeds
- . . . uniform acceleration
- . . . size of power unit based on running load instead of starting load

Users of small motors and internal combustion engines can now have all the advantages of fluid drive—at a very low cost. Twin Disc Hydraulic Engineers have designed a new hydraulic-conversion unit especially for small motors and engines. The new Twin Disc Hydro-Sheave Drive is a complete, easily-installed, low-cost transmission unit.

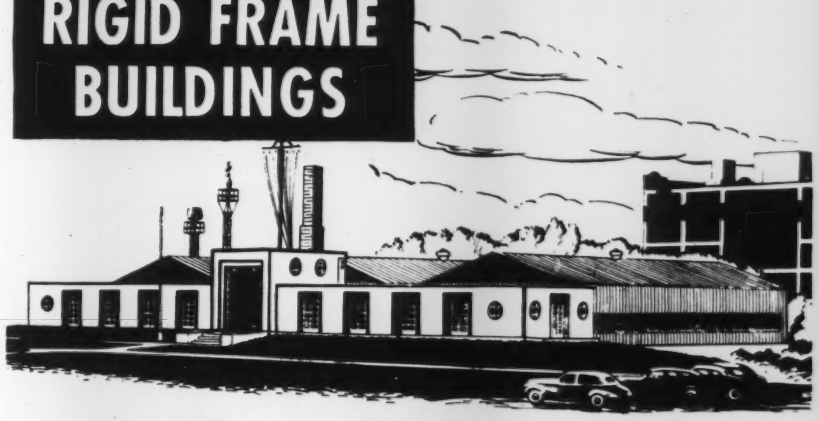
The Hydro-Sheave Drive is as easy to install as an ordinary sheave . . . sliding over the motor or engine shaft where it is held in place by three set screws. The unit is ready for immediate use . . . filled with hydraulic fluid . . . anti-friction bearings lubricated for life. Twin Disc Hydro-Sheave Drive is designed especially for use with Worthington QD (quick detachable) Sheaves, and is available in five sizes for use with any motor or engine in the ¾ to 25 hp range.

Built by the largest manufacturer specializing in friction clutches and hydraulic drives, Hydro-Sheave Drive is the simplest and most economical fluid power transmission available today. For complete information, including prices and the location of your nearest distributor, write to the Hydraulic Division for Bulletin 145. TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).

SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

"family day" at which some 500 employees and others were guests . . . ACME MILLWORK, INC., has moved into a new plant at Kirkland, Wash., its sales offices remaining at 933 Westlake Ave., Seattle 9, Wash. . . . Establishment of a Pacific Coast division of OWENS-CORNING FIBERGLASS CORP. and the appointment of L. R. Kessler as its general manager have been announced. The fifth U. S. plant of the company is being built at Santa Clara, Calif. . . . Operations at the newest U S. PLYWOOD CORP. plant at Shasta, Calif. probably will reach a production rate of 60,000,000 sq. ft. per year by Jan. 1 . . . About 25 foreign students have gathered at WORTHINGTON PUMP and MACHINERY CORP.'s. Harrison, N. J., plant to start a 6-months' training program on pumping equipment, condensers, feedwater heaters, water softening, diesel and gas engines, compressors, power transmission equipment, steam turbines, rock drill, air conditioning and refrigeration equipment. Part of the course will be at the Buffalo and Wellsville, N. Y., and Holyoke, Mass., plants . . . THE FEDERAL BEARINGS CO., INC., Poughkeepsie, N. Y., has announced price increases varying according to type of product. The reason — continually mounting material and operating costs. . . . The MCCLANAHAN SUPPLY CO. has been formed in Columbus, Ohio, to distribute in central Ohio a line of specialized truck equipment. . . . In the *Financial World's* annual report survey, for the fourth consecutive year, DRESSER INDUSTRIES, INC., Cleveland, Ohio, was judged to have had the best-appearing 1947 annual report. More than 4,000 corporation annual reports were considered. In the building equipment industry category, YORK CORP., York, Pa., was runner-up for the honors, and MINNEAPOLIS-HONEYWELL REGULATOR CO., Minneapolis, Minn., took third place. . . . The new address of EDELAN & BEYER CO., contractors' and industrial equipment and replacement parts, is 1,717 North 54th St., Philadelphia, 31, Pa. . . . ACME MILLWORK, INC., Seattle, Wash., expanding its production, has bought the former Navy warehouse building at Kirkland, Wash., giving it 50,400 sq. ft. of clear floor space. . . . THE OLIVER CORP. has moved to new offices at 52 Broadway, New York 6, N. Y. This is a district office of the industrial division. . . . Extensive expansion at the Elyria parts division of the THEW SHOVEL CO., Cleveland, Ohio, is completed. . . . Formation of the HAMILTON-THOMAS CORP., Hamilton, Ohio, to operate ECONOMY PUMPS, INC., KLIPFEL MFG. CO., and LIBERTY PLANERS, INC. is announced. . . . A $4,000,000 order for 700 trailers to haul Lustron houses has been given Fruehauf Trailer Co.

ADAPTABLE RIGID FRAME BUILDINGS



-cut High Building Costs!

You Get All These Features Already BUILT INTO Your BUTLER Steel-Aluminum Building

- Rigid Frame, Truss-Clear Design
- Bolted Construction
- Die Formed Eaves
- One-Piece Roof Ridge Sheets
- Low Cost Per Square Foot
- First Quality Aluminum Sheet Covering
- Permanent, Weather-Tight Construction

WIDELY USED FOR

Garages • Warehouses • Offices • Display Rooms • Farm Crop and Machinery Storage • Machine Shops • Packing Sheds • School Buildings • Truck Shipping Terminals • Oil Industry Housing • Railroad Control Stations • Other Industrial, Commercial, Farm Purposes.

See how quickly and economically you can adapt these Butler rigid frame buildings to your specific needs. Variations on the basic building can easily be made by local contractors.

You save on initial cost. Factory fabrication is much faster, more efficient, costs less than on-the-site construction. Buildings are easily assembled in days instead of weeks.

You save on heating, lighting and painting. Quality aluminum covering gives permanent weather-tight protection, requires no painting. Doors, windows located according to your specifications.

Available in wide variety of sizes. See your nearest Butler dealer or distributor, or mail coupon today for detailed information.

BUTLER STEEL-ALUMINUM BUILDINGS

The First Rigid Frame, Truss-Clear Design To Be Mass-Produced

BUTLER MANUFACTURING COMPANY

Factories: Kansas City, Mo., Galesburg, Ill., Richmond, Calif., Minneapolis, Minn.

BUTLER

For Prompt Reply, Address: **7418 E. 13th St., Kansas City 3, Mo.**
918 6th Ave., S. E., Minneapolis 14, Minn.
Dept. D P. O. Box 1072, Richmond, Calif.

Please send information on Butler Buildings, viz:

- ☐ 60 Ft. Width
- ☐ 50 Ft. Width
- ☐ 40 Ft. Width
- ☐ 32 Ft. Width
- ☐ 20 Ft. Width

FIRM NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

Those Small Jobs Go Easier and Faster with

SYNTRON

Construction and Maintenance Tools

Busting concrete, digging clay, shale and frozen ground; cutting asphalt and tamping backfill—with Gasoline Hammer Paving Breakers.

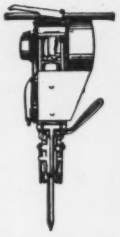
Drilling, cutting, chipping concrete and masonry; vibrating concrete forms and molds; scaling concrete, rust and old paint from equipment—with Electric Hammers.

Drilling, sanding, buffing and polishing wood and metal with Electric Drills and Sanders. Grinding welds and wire brush work with Electric Grinders.

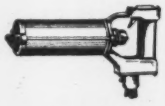
Vibrating thin wall forms; burial vault forms, pipe forms and other precast concrete products with electromagnetic Form Vibrators. Vibrating bridge decks, floor slabs, piers, etc. with flexible shaft Mass Vibrators.

Write for literature on this TIME AND COST SAVING equipment.

SYNTRON CO.
328 Lexington, Homer City, Pa.



"Gasoline Hammer"
PAVING BREAKERS
100% Self Contained



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ELECTRIC HAMMERS

"Portable"
ELECTRIC DRILLS

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Portable Electric
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MacArthur

38 YEARS INSTALLING PILES
OF EVERY TYPE

CAST-IN-PLACE CONCRETE COMPOSITE
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SOIL AND ROCK BORINGS

MacARTHUR CONCRETE PILE CORPORATION
18 EAST 48th STREET, NEW YORK 17, N. Y.
CINCINNATI • NEW ORLEANS

50th Anniversaries—Early in October the 50th anniversary of THE GOODYEAR TIRE and RUBBER CO. was celebrated in a 3-day program at Akron, Ohio . . . To mark its golden anniversary the AMERICAN NICKELOID CO., Peru, Ill., issued an attractive souvenir booklet giving the history of the company and illustrating its progress . . . In September the METALLIZING ENGINEERING CO., Long Island City, N. Y., observed its half-century of existence. It now employs about 125 persons, with sales and service offices in 25 principal cities.

Men and Jobs

R. F. Goudey, former sanitary engineer for the Los Angeles Department of Water and Power, has opened a private office and sanitary engineering laboratory in Glendale, Calif. He will specialize in all types of water treatment problems as well as the treatment, conservation and the disposal of sewage and industrial wastes. Goudey is a former national director of the American Water Works Association.

H. G. Smith has retired as engineer of sewer design for the city of Los Angeles. The design of the 245-mgd. capacity Los Angeles treatment plant at Hyperion was under his guidance. During World War I he served as a colonel in the Army. His successor is **E. G. Studley.**

John N. Robertson was appointed director of highways of the District of Columbia recently. Former deputy director of the highway department, he was promoted by the District Commissioners to succeed Capt. H. C. Whitehurst, who died September 1 (ENR Sept. 9, p. 10). Mr. Robertson will take charge of an $8,000,000 a year budget, a force of 900 men, and problems involving the city's bridges, trees, electrical department, municipal garage, and streets.

James Lambeth has been named acting city engineer at Raleigh, N. C., succeeding Public Works Director C. L. Berhart who has been named city manager at New Bern, N. C. He received his civil engineering degree from North Carolina State College.

W. H. Carrington, Waynesville, N. C., civil engineer, is working on the Clark Hill Dam in Georgia.

GRINNELL PROVIDES

THE PRODUCTS . . .
THE FACILITIES . . .
THE EXPERIENCE

Whether your piping layout involves installing simple water and air lines, protecting buildings from fire, supplying heat or humidification or transporting steam under 1,500 lbs. pressure, Grinnell provides the products, facilities and the experience for a *complete one-stop piping service.*

Grinnell manufactures a broad line of piping products and carries a complete stock of pipe, valves, fittings and piping specialties in strategically located branch warehouses . . . supplies prefabricated piping sub-assemblies ready to install . . . can help you engineer your piping system.

Branch Warehouses

Atlanta 2, Ga.	Kansas City 16, Mo.	Philadelphia 34, Pa.
Charlotte 1, N. C.	Long Beach 10, Cal.	Sacramento 14, Cal.
Chicago 9, Ill.	Los Angeles 13, Cal.	St. Louis 10, Mo.
Cleveland 14, O.	Milwaukee 3, Wis.	St. Paul, Minn.
Cranston 7, R. I.	Minneapolis 15, Minn.	San Francisco 7, Cal.
Fresno 1, Cal.	New York 17, N. Y.	Seattle 1, Wash.
Houston 1, Tex.	Oakland 7, Cal.	Spokane 15, Wash.

GRINNELL

GRINNELL COMPANY, INC.
Providence 1, R. I.

KINNEY
BITUMINOUS DISTRIBUTORS

EASY CONTROLS FOR SPEEDY APPLICATION

The Kinney Distributor provides complete control right at the operator's fingertips. A large handwheel gives full and accurate sidewise control of the spray bar . . . eliminates overlap of strips . . . permits faster truck speeds. One simple, three-way valve controls the entire operation of the Kinney Distributor—from loading to circulating to the actual spraying. This single valve, either manually or air operated, is the simplest control on the market; it's speedy, leakless, efficient. The Kinney Distributor handles all grades of bitumen used in road work: tar, asphalt, road oil, cut back, and emulsions. Its Jacketed Rotating Plunger Pump works with meter-like accuracy and finishes each job exactly to specifications.

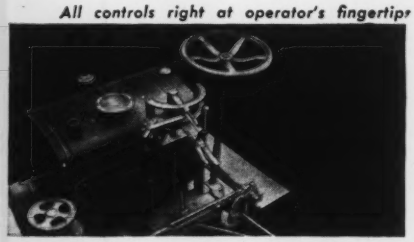
Write for new Bulletin A-48.

KINNEY MANUFACTURING CO.
3527 WASHINGTON STREET
BOSTON 30, MASS.

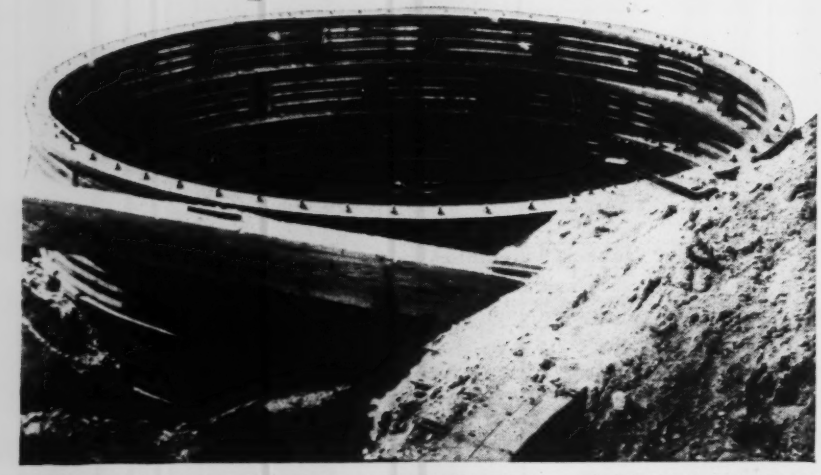
New York • Chicago • Philadelphia
Los Angeles • San Francisco

We also manufacture Vacuum Pumps, Liquid Pumps and Clutches

All controls right at operator's fingertips



If you're building for permanency, —use permanent materials!



COMMERCIAL TUNNEL SUPPORTS

For permanent stability in any kind of ground, use COMMERCIAL Supports — stronger and last longer! Write for details.

THE COMMERCIAL SHEARING & STAMPING CO. YOUNGSTOWN 1, OHIO

Alfred E. Newhouse has resigned as city engineer at Wooster, Ohio, to become chief engineer at the Ohio Experiment Station in that city.

Charles Dahlgren is city engineer of St. Peter, Minn., and assistant professor of engineering at Gustavus Adolphus College.

Leonard D. Norsworthy, assistant chief of the engineering division, Office of the Chief of Engineers, since 1942, retired Sept. 29 after 34 years of government service. After graduation from Webb Institute of Naval Architecture in 1900, he served as a draftsman for the Navy Department for five years. Later he became an assistant professor of mathematics at Grinnell College and then of civil engineering at Columbia University. He joined the office of the Chief of Engineers as a member of the Board of Engineers for Rivers and Harbors in 1919.

William N. Buckley, 69, an assistant city engineer in San Francisco, retired recently after 40 years service with the city.

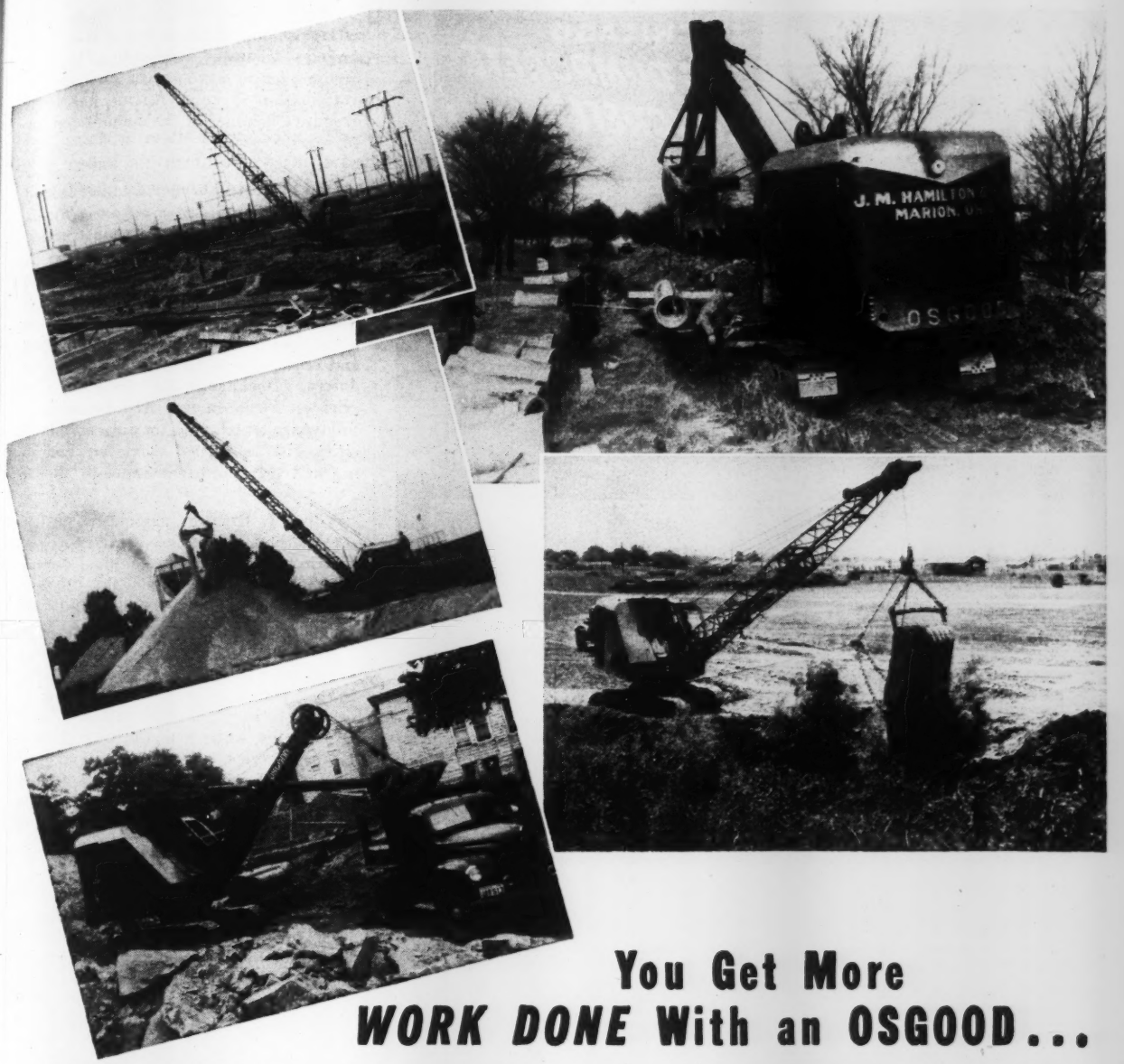
Clifford Hamblin, superintendent of the waterworks and disposal plants of Mason City, Iowa, is now acting city engineer.

W. E. Briscoe is assistant city engineer of Kansas City, Kan.

Appointment of **Harry G. DeWitt,** of Waverly, Pa., as project engineer with headquarters at Scranton, has been announced by the Pennsylvania State Highway Department. **Harry C. Miller,** of Meadville, has resigned as project engineer in District 11, Pittsburgh.

Ralph Stout, Greensboro, N. C., mapping engineer, has been retained by the Guilford County Commissioners at Greensboro, to make a survey in an effort to settle a controversy over the location of the Guilford-Randolph County line.

D. F. Horton, of the beach erosion department, U. S. Army Engineers, Washington, and B. Blackman of the Atlanta Regional Office of Army Engineers, and N. C. Magnuson of the Wilmington, N. C., office of Army Engineers, have begun a survey of the North Carolina coast from Masonboro Inlet to Oregon Inlet in connection with a program of coast and inlet improvements to be made in that region.



You Get More *WORK DONE* With an OSGOOD...

"WORK DONE" is the best measure of value. Put an OSGOOD in any kind of service and watch it perform. Check its efficiency, its speed, its versatility; observe its maneuverability, its ease of operation, the minimum amount of service it requires as a Shovel, Dragline, Crane, Clamshell, or Hoe. Compare its total yardage, its low cost of operation with that of any comparable equipment—that's the real test. Yes, whatever the job, you'll do it best with an OSGOOD.

Gasoline, Diesel or Electric powered . . . ⅜ to 2½ cu. yds. Crawlers or Mobilcranes. Write for descriptive literature and specifications.

POWER SHOVELS • CRANES • DRAGLINES • CLAMSHELLS • BACKHOES • PILE DRIVERS

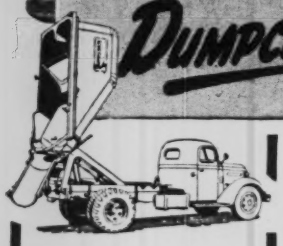
THE OSGOOD CO. O-G THE GENERAL CO.
EXCAVATOR

MARION OHIO

DIESEL, GASOLINE OR ELECTRIC POWERED • ⅜ TO 2½ CU. YD. • CRAWLERS & MOBILCRANES

IN CHICAGO
IT'S DUMPCRETE CONCRETE* AGAIN!

DUMPCRETES HAUL 14 MILES IN CHICAGO TRAFFIC



The Imperial Ready Mix Company's 14 Dumpcretes are busy hauling top-quality air-entrained concrete in and around Chicago.

The above photo shows a Dumpcrete pouring foundation piles at the new A. B. Dick Co. plant after a 14-mile, 50-minute haul.

By controlling the mix at the central plant, every load is uniform. Each has just the right amount of air to maintain top-to-bottom uniformity. No additional air is beaten into this "controlled mix" by the non-agitating Dumpcretes during the haul . . . so the delivered concrete is all according to specification.

The Dumpcretes save money too. They cost less to buy and less to run.

Every concrete man wants to deliver better concrete at lower cost. Write for complete information today.

The Dumpcrete Body

Lightweight, watertight, loads fast, dumps fast or slow, places anywhere, costs less to buy and run. Ideal for hauling aggregate, coal and earth.

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*** Dumpcrete Concrete**

is central-mix air-entrained concrete hauled and placed with the speedy, low-cost Dumpcrete. Provides top-quality, plastic, workable and non-segregating concrete, saving up to $1.00 per yard.

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Arthur H. Adams has been named acting planning director of the Los Angeles County Regional Planning Commission to serve until a civil service examination is held. Adams has been executive member of the commission for 10 years.

Don F. Gerstenberger, head of Inland Empire Refineries at Spokane, Wash., since he supervised its construction several years ago, has been selected by Ralph M. Parsons Engineering Co. to head an ECA cooperative mission to China. The objective of the mission is a complete survey of the engineering and economics of China's petroleum industry. Dockage, pipelines and refineries on Formosa will first be studied, following which the major mainland cities will be studied from the marketing and transportation angles.

Floyd J. Brinley, associated professor of biology at the University of Toledo, is heading a biological survey of the Maumee River along its 120-mile length from Fort Wayne, Ind., to Toledo, Ohio. From the results, it is hoped that more cities and towns along the river will be persuaded to install sewage treatment or disposal plants to prevent further pollution of the stream. Dr. Brinley, while with the U. S. Public Health Service, assisted in a four-year survey of the Ohio River in which more than 10,000 water samples were taken to determine the effects of sewage on the river's aquatic life.

Wayne M. Dornbirer, for the past six years chief engineer for the James I. Barnes Construction Co., Orlando, Fla., has become general manager of Leo E. Ruisinger, Inc., Columbus, Ohio, general contracting and construction firm.

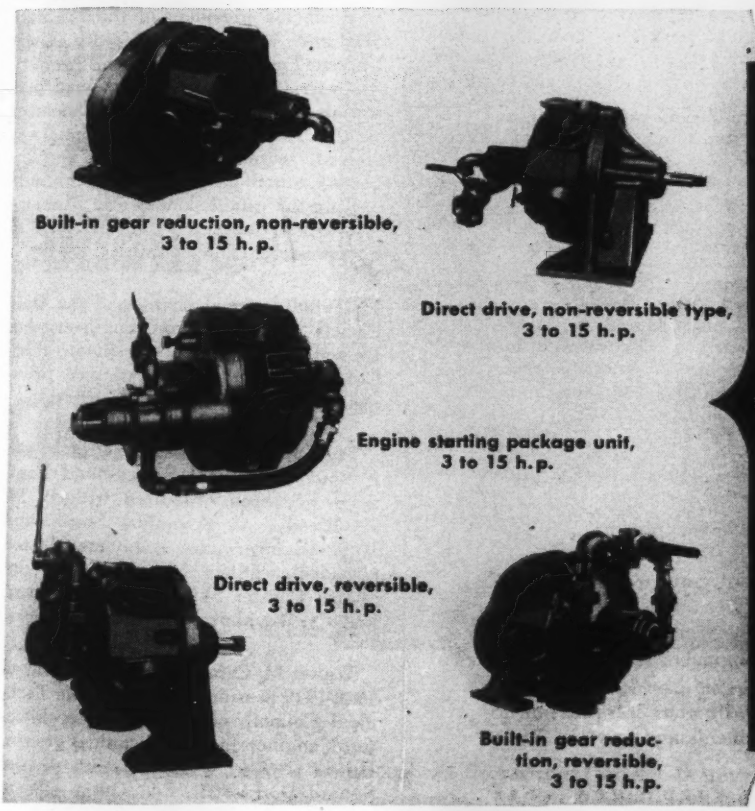
A. H. Samborn & Associates, Toledo Terminal Bldg., Toledo, Ohio, has been formed by Mr. Samborn, formerly with Giffels & Vallet, Detroit. During the war he was with the 17th Construction Battalion, which designed and constructed the 3,000,000 gpd. water supply on Okinawa.

Angus T. Johnson, Milford, Conn., formerly supervisor of the design operations section of the engineering department at the Chance Vought Division of the United Aircraft Corp., Stratford, Conn., has been appointed to the new post of secretary to the Town Plan and Zone Commission. He was graduated from Syracuse University and took post-graduate courses in municipal planning and design. He was employed as site planner and designer with the National Park Service.

NO other kind of power excels *air* power in safety, flexibility, freedom from damage due to overloading, and simplicity of control. That's why Gardner-Denver air motors find such a wide application. These 5-cylinder radial air motors are remarkably compact. They can be controlled to operate at any desired speed up to their maximum r. p. m. They have unusually high torque for high starting loads. They are simple, durable and light in weight

for greater flexibility, safety, convenience . . .

GARDNER-DENVER AIR MOTORS



Built-in gear reduction, non-reversible, 3 to 15 h.p.

Direct drive, non-reversible type, 3 to 15 h.p.

Engine starting package unit, 3 to 15 h.p.

Direct drive, reversible, 3 to 15 h.p.

Built-in gear reduction, reversible, 3 to 15 h.p.

MINING—Shaft muckers, ore chute gates, mine hoists, mine locomotives, bit grinders, diamond drills, ventilating fans and blowers.

CONSTRUCTION—Grout and concrete mixers, earth augers, conduit augers, bit grinders.

INDUSTRIAL—Gas line and pipe cleaners, conveyor belts, mixers, blast furnace doors, pumps, bending rolls.

MARINE—Engine starting, jib cranes, ship steering units, capstans, towing winches.

SAWMILLS & LOGGING—Chain saws, sawmill carriages, edger feeds.

OIL FIELD—Engine starters, blowout preventer valves, hydraulic pump drives.

For complete information, write Gardner-Denver Company, Quincy, Illinois

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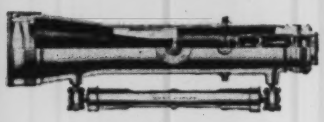
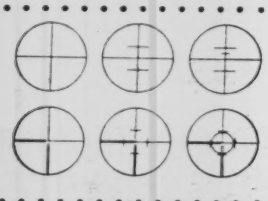
These transit "specs" were written in the field



Large objective lenses with assurance of a flat, brilliant, color-free image. Lenses are ground and polished in Gurley's optical department, meet theoretical limit of optical power; coated if desired.



Quick-reading glass reticles in several patterns provide for all surveying requirements and climatic conditions. Short stadia lines are easy to identify, prevent confusion with regular cross-lines.

Clean-cut, accurate graduations on non-tarnishing surface. Limbs are made of a specially forged and heat-treated alloy for rigidity and light weight.

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Elections and Activities

The Seabee Veterans of America have elected Capt. Howard P. Potter, of Chicago, veteran naval reserve construction officer, president. Other officers elected were Nelson Francisco, Jeffersonville, Ind., vice-president at large; Leon James, Omaha, Neb., secretary; Leo F. Crowley, Detroit, treasurer. Regional vice-presidents named included Carlton Pickett, New York City, for the Northeast district. The delegates chose Atlantic City as the site of their second convention, to be held Sept. 9-11, 1949.

Arthur M. Jurrus, Toledo, Ohio, has been elected president of the Tri-State Soil and Water Council, with Louis Dunten, Fort Wayne, Ind., and Mark S. Andrews, Coldwater, Mich., named vice-presidents. Robert C. Ragan, member of the Toledo Port Commission, was elected secretary-treasurer. The Tri-State Council passed a resolution supporting the establishment of a Maumee Watershed Conservancy District in 15 northwestern Ohio counties.

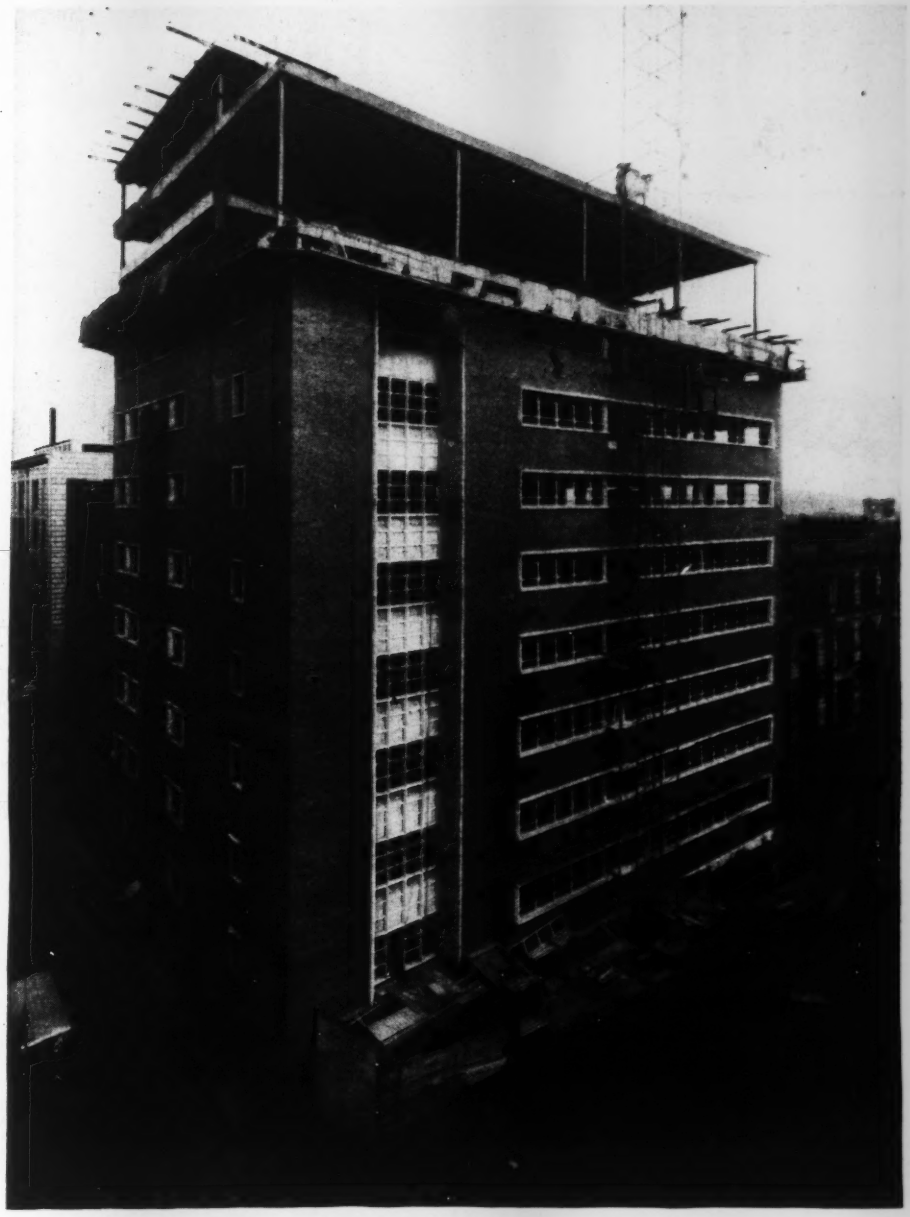
Canton regional chapter of the Ohio Society of Professional Engineers has elected Lewis Cisler, president; Earl Curtis and William Borst, vice presidents and Lawrence Turner, secretary.

The Jacksonville, Fla., chapter of the National Society of Professional Engineers has been organized with P. M. Huddleston of Reynolds, Smith and Hills, engineers and architects, elected president. Other officers elected included Chester Skinner, vice-president, and Cy Washburn, secretary-treasurer.

Walter M. Campbell has been elected 1948-1949 president of the Toledo Technical Council, comprising 16 architectural, engineering and technical groups. He is a field representative of the Square D. Electric Co. Other officers are: Fred W. Gilchrist, chief sales engineer for Toledo Scale Co., vice-president; and Chester A. Colwell, Willys-Overland Motors, Inc., tool design department, secretary-treasurer.

Officers and directors of the County Engineers Association of Ohio recently adopted a resolution calling for a 50 percent raise in the gasoline tax and automobile license fees. Alberts Porter, Cleveland, Cuyahoga County engineer and president of the group, said the proposed increase would bring the gaso-

New Store Building In Cincinnati



Architects and Engineers: Harry Hake and Harry Hake, Jr., Cincinnati.
General Contractor: Guentter-Reinhard Co., Cincinnati.

Pogue's, one of Cincinnati's better-known department stores, is improving shopping facilities for its thousands of customers by putting up this modern addition.

To be known as The H. & S. Pogue Company Service Building, the new ten-story-plus-penthouse structure occupies an 81 ft x 121 ft tract, and is located but a stone's throw from the parent building. Fabrication and erection of its steel frame, involving more than 1300 tons of structural steel, were handled by Bethlehem.

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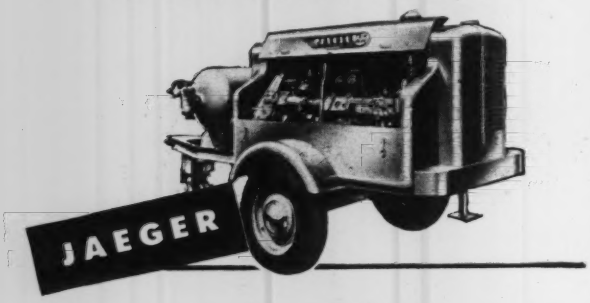
MORE AIR
TO RUN MORE TOOLS



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New Standard 125 ft. "Air Plus" can run 2 big breakers, or 3 medium breakers, 4 clay spades or 2 heavy sheeting drivers at full 90 lbs. pressure — do 30% to 40% more work than the same tools under mere 70 lbs. pressure.

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All other new sizes are comparable. See your Jaeger distributor or get new Catalog JC-8.

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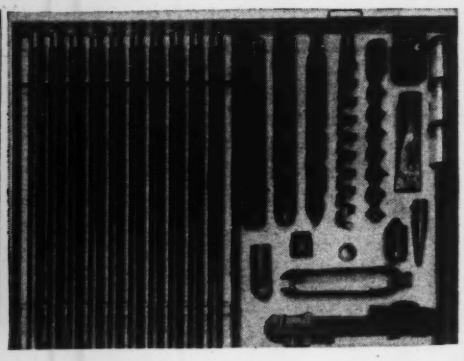

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- Twelve soil and earth sampling tools in handy steel box.
- Can be carried in any automobile.
- Depths limited only to driving power of sledge or maul.

- Thirty years' experience has proved these tools will recover accurate samples from practically all earth materials.
- MANY USES include aluminum silicate deposits—brick and clay materials—foundation test borings—gold bearing sands—kaolin and clay for ceramics—sand and gravel pits—subgrade testing for highways and airfield runways—base materials.

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line tax from four to six cents a gallon, and the automobile license from $10 to $15 a year for passenger cars. Two months earlier, the association asked for a flat 4-cent increase in the gasoline tax.

Charles E. McKee, Columbus, secretary of the Ohio Contractors Assn., has been named executive secretary of the Associated Ohio Construction Employers for the balance of the year, to fill the vacancy created by the resignation of A. C. Morley.

John J. Loustaunau of E. B. Badger & Const. Co., Boston, succeeds Frederic C. Bacon Jr., as president of the Massachusetts Society of Professional Engineers. Mr. Loustaunau received his B. S. and S. M. degrees from Massachusetts Institute of Technology and has been a member of the E. B. Badger & Sons Co. staff since 1942.

A long sought objective of having 1,500 members on its roster has been achieved by the Engineers' Society of Milwaukee, Wis., following a membership campaign held in the last month.

J. B. Thomas of Fort Worth has been elected chairman of the Texas State Board of Registration for Professional Engineers. E. W. Pittman of Beaumont is vice-chairman and Carl L. Svensen of Lubbock, secretary.

Officers of the Northern Virginia Society of Professional Engineers for the coming year are: President, Lester V. Johnson, Arlington; 1st vice-president, Herbert Manuccia, Alexandria; 2nd vice-president, James Corbalis, Fairfax; secretary-treasurer, Edward Holland, Alexandria; director for 1 year, Nathan Levy, Arlington; director for 2 years, L. E. Reed, Alexandria; director for 3 years, Paul Rupert, Arlington.

C. H. Williams, chief engineer of the Carnegie-Illinois Steel Corp., Pittsburgh, Pa., has been elected president of the Association of Iron and Steel Engineers. A. S. Glossbrenner, assistant vice-president in charge of operations for the Youngstown Sheet & Tube Co., was elected first vice-president; John F. Black, general superintendent at Buffalo plant of Colorado Fuel & Iron Co., second vice-president; J. L. Young, vice-president of National Tube Co., Pittsburgh, secretary; and I. N. Tull, electrical superintendent for Republic Steel Corp., Cleveland, treasurer.

City Engineer W. J. Leseman, Jr., of Daytona Beach, Fla., has been elected president and Phil H. Walker,

AT DETROIT WATER WORKS, for over 10 Years *Limitorque* Valve Operators have been in constant use

"LimiTorques" assure safe, speedy, economical and absolutely dependable opening and closing of valves through motor actuated, push-button operation (either local or remote control).

"LimiTorques" not only save time, labor and money in operation, but they *prevent costly damage* to Stems, Valves and Discs, (caused by obstructions) because they *shut-off the power* through an "exclusive" torque cut-off. They are in use on globe, gate, butterfly, plug valves, and sluice gates . . . for service with water, steam, air, oil, gas or process liquids. Our new 96 page catalog gladly sent upon request on your Business Letterhead.

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Yonkers Sewage Treatment Plant, N. Y.
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City of Stevens Point, Wis.
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Saving Ways in Doorways
KINNEAR
ROLLING DOORS

secretary-treasurer of the newly formed Daytona Beach chapter of the Society of Professional Engineers of Florida.

The fourth Pan American Consultation on Cartography is being held at Buenos Aires, Argentina. It is a meeting of the Commission on Cartography, one of several technical commissions of the Pan American Institute of Geography and History. Its purpose is to further the surveying and mapping activities of the member governments of the institute. The Department of State has announced the make-up of the U. S. delegation as follows:

Chairman: Robert H. Randall, Bureau of the Budget, Executive Office of the President; U. S. member and chairman, Commission on Cartography, Pan American Institute of Geography and History.

Delegates: Lt. Col. Albert G. Foote, Commanding Officer, Aeronautical Chart Service, Department of the Air Force; Capt. Clement L. Garner, (Retired), former chief, Division of Geodesy, U. S. Coast and Geodetic Survey, Department of Commerce; Charles B. Hitchcock, assistant director, American Geographical Society; Capt. Allen Hobbs, hydrographer of the Navy, Department of the Navy; Col. John G. Ladd, Office of Chief of Engineers, Department of the Army; Col. Freemont S. Tandy, chief, Inter-American Geodetic Survey, Caribbean Defense Command, Canal Zone; and Marshall S. Wright, technical assistant to the Chief, Office of Plans and Operations, Department of Agriculture.

E. A. Crump, engineer for the North Carolina State Highway Department at Wilson, N. C., has been re-elected president of the North Carolina State Highway Employees Association. Other officers re-elected are: T. F. Royall of Wadesboro, vice-president; and Otis M. Banks of Raleigh, secretary-treasurer. The association adopted resolutions favoring a proposed state constitutional amendment prohibiting diversion of retirement funds to any other function of the state government, and approving a proposed state personnel act which would set up a separate personnel bureau for state employees instead of having them come under the Budget Bureau, as at present.

The second annual Virginia Highway Conference will be held at the Virginia Military Institute, Lexington, Nov. 11-13. The conference is jointly sponsored by the State Highway Department and the VMI department of civil engineering. The conference this year will be devoted to a study of road problems confronting the counties, towns, cities and the state.

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Engineering Schools

Eighty-one engineering students from colleges and universities in 17 states took on-the-job training at Bureau of Reclamation projects in the Pacific Northwest during their summer vacation. Here seen at Hungry Horse damsite are Joseph B. Eastman, Oregon State College, John C. Neupauer, Newark College of Engineering, and A. A. Brownson, Bureau Engineer. The program, launched by the Bureau this year, gives sophomores and juniors an opportunity to work in the field with experienced engineers. They are paid. The program will be offered each year on Bureau projects in 17 western states.

Traffic Engineering

Staff appointments for the University of California's new Institute of Transportation and Traffic engineering (ENR, Sept. 2, p. 55) have been announced by Acting Director Harmer E. Davis, follows:

Donald S. Berry will be assistant director and professor of transportation engineering, Ralph A. Moyer professor of civil engineering and research engineer.

Berry joins the UC staff after 12 years as traffic engineer with the National Safety Council and 5 years as director of its traffic and transportation division. He holds a BS degree from the South Dakota School of Mines, an MS in highway engineering from Iowa State College and a PhD. in civil engineering from the University of Michigan.

Moyer formerly was research professor of civil engineering at Iowa State College, where he received his bachelor's and master's degrees in civil engineering. In the last 20 years he has made

studies with different types of cars and trucks on all types of road surfaces to determine variations in operating costs, tire wear, coefficient of friction and road roughness properties.

Appointed as lecturers were Cecil J. Van Til and Fred N. Finn. Van Til came from Purdue University where he received his M.S. in civil engineering. Finn has a B.S. degree in civil engineering from the University of New Mexico and has done graduate work in soils mechanics at UC.

Offered in the fall term by the institute will be graduate seminars in highway planning and design, traffic engineering, and airphoto interpretation. Courses available in other departments are inland transportation, introduction to city and regional planning, advanced structural analysis and design, and concrete construction practice. Also to be included in graduate programs of study are airport planning and design, transportation economics, highway structures and highway materials.

Military Surveys

With cooperation of the city of Boston and Massachusetts engineering schools, a group of 150 officers and enlisted men of the Army Engineer Reserve conducted maneuvers in the Hingham, Mass., area recently with engineering and surveying equipment valued at more than $100,000. It had been lent to the reservists by M.I.T., Northeastern University, Harvard, Tufts, Boston University and Franklin Institute.

Young Engineers' Salaries

June, 1948, graduates in engineering and science at Illinois Institute of Technology are drawing average starting monthly salaries of $264.72. Chemical engineering graduates topped the field, commanding an average of $282.90. Civil engineers at $280.73 were second. Industrial engineers get $264.25; mechanical engineering graduates, $261.26; electrical engineers $260.46; and fire protection and safety engineers, $254.49. The entire class average of $264.72 is more than two and one-half times greater than the normal starting pay of engineering and science graduates 10 years ago.

Road Engineering Course

Twelve-week courses in highway engineering are being conducted at the University of Florida in cooperation with the state road department and under the supervision of Radnor J. Paquette, assistant professor of civil engineering. Students are full time engineering employees of the road department.

CONSTRUCTION REPORTS

Proposed Work

Compiled by Business News Department—Engineering News-Record, 330 W. 42nd St., New York 18, N. Y.
ELSIE EAVES, Manager J. A. MAHONEY, Reports E. R. BIGGERSTAFF, M. R. ROESSLER, Statistics

WATER SUPPLY

PROPOSED WORK

Ark., Searcy—City, WW sys. imprvs. **$100,000.** K. W. Lefever, Gazette bldg., Little Rock, consult. engr.

Ind., Lagro—Town Bd., WW. sys., incl. deep well, pump house, deep well pump, watermains, elevated steel tank, fire hydrants. **$150,000.** Snyder & Wolford, Hillsboro, engrs. CD 10/30/47—ENR 11/6/47.

Kan., Manhattan—City, City Hall, WW. sys. exten., imprvs., incl. water softening plant, equipment to raise capacity to 4.5 m.g., water-main extens., pump. equip., settling basins, filters, housing, etc. **$310,000.**

La., Franklin—Town, voted bonds, WW imprvs. **$266,000.** CD 8/27.

Mass., Brookline—Town, Eng. Dpt., Brookline surface water drains, Griggs Rd. **$100,000.**

●**Mo., Columbia**—City, Marvin P. Blackmore, mayor, City Hall, impounding dam and water supply lake Hinkson Creek. **$1,844,000.** Black & Veatch, 4706 Broadway, Kansas City, 2, Mo., engrs.

N. C., Shelby—Town, H. S. Woodson, mayor, voted bonds, WW imprvs. **$250,000.** CD 3/13—ENR 4/1.

O., Mt. Gilead—City, bond election Nov. 2, WW imprvs. **$110,000.**

O., Van Wert—City, **$625,000** bond election Nov. 2, reservoir relieving water shortage, CD 5/9/45—ENR 5/17/45.

S. D., Huron—City, water softening plant. **$600,000.** E. H. Dunmire, 2774 South St., Lincoln, Neb., consult. engr.

Tenn., Gatlinburg—City, WW imprvs. **$580,000.** Wallace & Clouser, Mercantile Bldg., Knoxville, consult. engrs. CD 1/27/47—ENR 2/6/47.

●**Tenn., Nashville**—City, City Hall, general enlargement WW. **$4,000,000.**

Tex., Daisetta—City, Otto Kochler, mayor, pro tem, WW sys. **$150,000.** Garrett Eng. Co., 1806 Milam St., Houston, consult. engr.

Tex., Mont Belvieu — Chambers County Water Control & Imprvt. Dist. 1, voted bonds, c.i. waterlines, **$70,000;** water storage and supply, **$110,000.** Garrett Eng. Co., 1806 Milam St., Houston, consult. engr. CD 9/29.

Tex., Pampa—City, C. A. Huff, mayor, 1 m. g. concrete ground storage tank, **$30,000;** pump station, **$30,000;** 3 gravel walled wells 380 ft. deep each, 3 brick, concrete pump houses, pumping units, **$72,000;** 3 mi. 16 in. supply line and 1 mi. 14 in. collecting line, **$130,000;** chlorinating units, **$18,000;** 500,000 gal. elevated steel storage tank, **$78,000;** watermain extens., fire hydrants, **$75,000,** all above work outside city limits. Merriman & Roberts, Pampa, engrs. D. G. Pepin, city engr.

Tex., Poteet—City, voted bonds WW sys. imprvs., extens. **$100,000.** J. V. Curnutte, 1615 Transit Tower, San Antonio, consult. engr.

Wash., Gig Harbor—Town, Town Hall, voted bonds, water supply, distr. sys. 250,000 gal. steel tank, well, etc. **$120,000.** Harstad, Harbeson & Assoc., Smith Tower, Seattle, Zone 4, consult. engrs. CD 9/2.

Ont., Beaverton—Village, F. R. McMillan, clk., WW sys., filtration plant at lake front, storage tank 48,000 ft. watermains. Approx. **$150,000.** Proctor, Redfern & Laughlin, 11 Jordan St., Toronto, engrs. CD 3/17—ENR 4/1.

Ont., Connington—Town, E. O. Pettet, clk., Town Hall, WW sys. Approx. **$150,000.** Proctor, Redfern & Laughlin, 11 Jordan St., Toronto, engrs.

Ont., Oakville—Town, Town Hall, twin intakes, from Lake Ontario to pumping unit. Approx. **$210,000.**

SEWERS, WASTE DISPOSAL

PROPOSED WORK

Calif., Bryte—Bryte Sanitary Dist., Bryte, defeated **$171,000** bonds sewage disposal works, CD 9/2.

Calif., Quincy—Quincy Sanitary Dist., King Bldg., voted **$180,000** bonds, sanitary sewerage sys., sewage disposal plant, Clyde C. Kennedy, 604 Mission St., San Francisco, consult. engr. CD 11/15/44—ENR 11/30/44.

●**Calif., Santa Rosa**—Sonoma Co. Sanitation Dist., Courthouse, **$3,000,000** bond election in November 10, sewerage sys. CD 6/30/45—ENR 8/9/45.

Calif., Willits—City, City Hall, voted **$125,000** bonds sewerage sys. imprv. Thomas & Whipple, 205 Hamilton Ave., Palo Alto, consult. engrs. CD 9/2.

Conn., Bridgeport—City, Pub. Wks. Dpt., Peter Brewster, dir., brick, concrete steel sewage treatment plant, treatment equip., Bostwick Ave. **$500,000.** Joseph A. Weinmann, 804 Main St., engr. CD 6/21/45—ENR 7/12/45.

Idaho, Buhl—City, City Hall, voted **$100,000** bonds, sewer imprvs., Dist. 11, J. L. Hoffman & C. C. Fiske, P. O. Box 1121, Boise, consult. engrs. CD 8/27.

La., Bastrop—City, City Hall, voted **$500,000** bonds, sanitary sewer imprvs. CD 8/12.

La., Franklin—Town, voted bonds sanitary sewer imprvs. **$100,000.** CD 8/27.

●**Mich., Saganaw**—City, City Hall, sewage treatment plant, **$6,600,000. (Correction**—location of project). CD 10/6, under Mich., Flint.

Mo., Clayton (St. Louis, Zone 5, P. O.)—City, C. Kenneth Thies, mayor, City Hall, 10 N. Bemiston St., sanitary and storm water sewerage sys. imprvs., extens. in various streets. **$870,000.** Hyman Shiffrin, Shell Bldg., 1221 Locust St., St. Louis, Zone 1, engr. CD 9/27—ENR 10/14.

●**Mo., St. Louis**—City, M. M. Kinsey, pres., 304 City Hall, 12 and Market Sts., St. Louis, Zone 3, $15,000,000 bond election, Nov. 2, trunk and relief sewers in Harlem Creek and Baden Sewer Dist., in northwest and northern part of city, **$12,500,000;** and in Glaise Creek Dist. in southern part, city **$2,500,000.** CD 8/5—ENR 8/12.

Mont., Kallspell—City, City Hall, sanitary sewers, drainage. **$150,000.** Morrison Eng. Co., Civic Center, Helena, consult. engr. for survey.

●**New York**—Dpt. P. Wks., Municipal Bldg., New York, Zone 7, Oakwood Beach Sewage Treatment Works, Richmond Boro. **$6,900,000.** To go ahead in 1949.

●**N. Y., St. George**—President Richmond Boro, 120 Boro Hall, St. George, Zone 1,
PR-79, Moravian Brook extens. from North Railroad Ave. to New York Bay. **$864,000.**
PR-82, storm water sewer to enclose Raymond Brook from Forest to Post Aves., **$230,000.** To go ahead after 1953.
PRS-90, storm water drains, Arthur Kill Rd., Tyrell to Main Sts., **$3,400.**
PRS-101, Glen Ave., Duer Lane to Brighton Ave., **$12,150.**
PRS-102, Grace Pl., Henderson Ave. to Cassidy Pl., **$1,950.**
PRS-115, culvert at Sideview Ave., **$5,150.**
PRS-124, storm water drains, Villa Ave., $4,850, all foregoing to go ahead in 1948, 1949, 1950.

O., Mansfield—City, **$500,000** bond election November 2, sewer imprvs. CD 10/16/44—ENR 11/2/44.

O., St. Bernard (Br. Cincinnati)—City, City Hall, concrete brick incinerator, stack and equip. **$100,000.** George Boehm, Vine and Baker Sts., service dir.

Pa., West Chester—West Chester Boro, sewage disposal plant addn. **$200,000.** Albright & Friel, Inc., 1528 Walnut St., Phila., consult. engr.

R. I., Providence—City, Dennis Roberts, mayor, City Hall, sanitary sewers in Rowley St., etc. **$300,000.** John E. Meade, city engr.

Tex., Daisetta—City, Otto Koehler, mayor, pro tem, sanitary sewerage sys. **$115,000.** Garrett Eng. Co., 1806 Milam St., Houston, consult. engr.

Tex., Mont Belvieu—Chambers Co. Water Control & Imprvt. Dist. 1, voted bonds, sanitary sewer lines, **$80,000;** disposal or treatment plant, **$100,000.** Garrett Eng. Co., 1806 Milam St., Houston, consult. engr. CD 9/29.

Tex., Pampa—City, C. A. Huff, mayor, remodeling, enlarging sewerage plant. **$107,000.** Merriman & Roberts, Pampa, engrs. Dick G. Pepin, city engr. CD 1/17/46—ENR 2/7/46.

Tex., San Antonio—City, Alfred Callaghan, mayor, sanitary sewer main, encircling east side Sherman St. Pumping Station. **$888,000.** Beavers & Lodal, 1509 Transit Tower, engrs. CD 12/15/47—ENR 12/25/47.

Wash., Seattle—W. E. Boeing, 1411 4 Ave. Bldg., Zone 1, sewerage sys., treatment plant for shopping center. **$100,000.** Morford & Mowry, Lyon Bldg., Zone 4, consult. engrs.

Man., Virden—Town, E. Anderson, clk., sewerage sys., disposal plant. Approx. **$280,000.** T. H. Porter, Portage la Prairie, engr. CD 9/7/45—ENR 9/13/45.

BRIDGES

PROPOSED WORK

Massachusetts—Commonwealth of Mass., Wm. H. Buracker, Comr. Pub. Wks., 100 Nashua St., Boston, rein.-con., steel bridge, about 1 mi. road construction, Dartmouth. **$115,000.** P. H. Kitfield, c/o owner, engr.

●**O., Zanesville** — Comrs., Muskingum Co., **$1,250,000** bond election Nov. 2, bridge across Muskingum River connecting Philo and Duncan Falls. CD 10/20/43—ENR 10/28/43.

Pennsylvania—State Hy. Dpt., Harr[illegible]rg, 3 span, 162 ft., four traffic lane steel, [illegible]n-con. bridge 72 ft. wide, carrying Rou[illegible]84 over Central R.R. Co. of Pennsylvania [illegible]R. tracks in Hometown Village, Schuylki[illegible]Co. **$614,000.** E. L. Schmidt, c/o owner, ch[illegible]gr.

●**Virginia**—Elizabeth River Tunnel [illegible]n., Richmond, bridge, tunnel or combinatio[illegible] between Norfolk and Portsmouth across [illegible]beth River, 4 lane, 150 ft. horizontal [illegible]ar-ance, bascule draw bridge between N[illegible]olk and Berkley across Eastern Branch of [illegible]zabeth River, and 2-lane tunnel between [illegible]rkley and Portsmouth under Southern B[illegible]nch of Elizabeth River. Parsons, Brinckerhoff, Hall & Macdonald, 51 Broadway, New York 6, N. Y., engrs. J. E. Greiner Co., 1201 St. Paul St., Baltimore, Md., consult engrs. CD 11[illegible]44—ENR 11/30/44.

Wash., Aberdeen—City, City Hall, bridge over Wishkah River at Heron St. **$37[illegible],000.** General Engr. Co., Central Bldg., Seattle, Zone 4, consult. engr. CD 9/28—ENR 10/14.

Ont., London—City Council, G. Wenige, mayor, will submit bylaw to ratepayers at December election, bridge Oxford St. **$200,000.** W. Veitch, city engr.

Quebec—Dpt. P. Wks., Quebec City, rein.-con. bridge over Harricana River. Approx. **$200,000.** O. Desjardins, c/o owner, engr.

Que., Sherbrooke—City, A Deslauriers, clk., bridge over St. Francis River. **$800,000.** Ratepayers approved. J. C. Cote, city engr. CD 9/22.

STREETS AND ROADS

PROPOSED WORK

†**Montana**—Bureau Reclamation, Dpt. Interior, Bldg. 1A, Denver Federal Center, Denver, Colo., relocation Forest Service Rd. between Riverside Creek and Elk Park, Hungry Horse Proj.

●**New York**—President Richmond Boro, Boro Hall, Staten Island, Zone 1
PR-50, widening and realignment, incl. land, Bay St., **$1,234,000.** To go ahead in 1950, 1951, 1952.
PR-52, Slosson Terrace Extens. and widening, incl. land, **$794,000.**
PR-76, VanDuzer St. By-Pass, incl. land, **$88,000.** To go ahead in 1949, 1950, 1951.
PRS-7, paving, Baltimore St., Colon Ave. to Giffords Lane, **$4,800.**
PRS-24, Duncan Rd., Eddy St. to Theresa Pl., **$3,050.**
PRS-32, Franklin Ave., Arnold St. to Prospect Ave., **$2,600.**
RS-37, Harbor View Pl., Bay St. to Wadsworth Rd., **$2,000.**
PRS-40, Holly Pl., Grace R. to Oakley Pl., **$2,150.**
PRS-42, Hull Ave., Richmond Rd. to Staten Island Rapid Transit R.R., **$4,400.**
PRS-51, Marscher Pl., Seguine to Van Wyck Ave., **$2,600.**
PRS-52, Mason St., Vista to Sparkhill Ave., **$8,550.**
PRS-59, N. Railroad Ave., Stobe to Otis Aves., **$43,700.**
PRS-79, Steele Ave., Richmond Rd. to N. Railroad Ave., **$4,400.**
PRS-83, Wakefield Rd., Woods of Arden Rd. to end, **$4,400.**
PRS-80, Sweetwater Ave., Wiman to Nelson Aves., **$3,050.**
PRS-82, Villa Ave., Richmond Ave. to Walker St., **$19,800.**
PRS-150, Delaware St., Dalemere Rd. to New York Bay, **$38,500.**
PRS-163, Harold St., Bradley to Suffolk Aves., **$4,400.**
PRS-167, Kiswick St., Miller Field to Hunter Ave., **$26,400.**
PRS-174, Nashville St. Amboy Rd. to 1,100 ft. west, **$4,850.**
PRS-179, Nugent Ave., Miller Field to Hunter Ave., **$26,600,** all foregoing to go ahead in 1948, 1949 and 1950.

N. Y., St. George—Dpt. Marine & Aviation, Pier A, North River, New York, Zone 14, widening Murray Hulbert Ave., D-210. **$110,000.** To go ahead after 1953.

●**O., Toledo**—City, City Hall, imprv. 80 residential streets and alleys **$1,200,000;** Union Station Plaza and imprv. Giant St. and Westland Ave. **$201,000** (1949); imprv. 80 residential streets and alleys, **$1,200,000,** imprv. 15 major streets, **$2,203,150;** Dorr St. New York Central Sys. grade separation, **$800,000** (1950); imprv. St. Clair St. from Swan Creek to Emerald Ave. **$70,000;** resurfacing Scottwood Ave. between Monroe and Central Sts. **$50,000.** CD 4/4/45—ENR 4/19/45.

Tenn., Humboldt—State Hy. Dpt., Nashville, resurfacing, rebuilding Main St. from Central Ave. to point on Hy. 51, **$250,000.**

Tenn., Nashville — City, repairing streets, incl. sealing roads for winter, resurfacing of some streets. **$100,000.** CD 11/21/45—ENR 12/13/45.

Puerto Rico, Ponce—Insular Dpt. of the Interior Govt., Puerto Rico, 4.00 kilometers of Ponce-Jayuya Municipal Road 51. **$200,000.**

EARTHWORK, WATERWAYS

PROPOSED WORK

†**Kansas**—U. S. Eng., 601 Davidson Bldg., 10 E. 17 St., Kansas City, Mo., administration facilities, incl. residences, earth work, septic tank, disposal field, administration bldg., removal existing bldgs., water supply, pump house, electrical distr. sys., driveways, and walks, at Kanapolis Dam Site, near Ellsworth, Eng. 23-028-49-71.